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DISCOVERY

A Monthly Popular Journal of Knowledge

June 1935

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IN THIS ISSUE

New Biblical Texts

By Sir Frederic Kenyon



The Future of British Mammals

By Eric Hardy



Art in African Literature By Capt. William Hichens



What are Scientists? — The Ethics of Headhunting — The British
Canning Industry — Detecting Milk Frauds — National Trust News

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DISCOVERY

A Monthly Popular Journal of Knowledge

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ship designs submitted to model tests has been the greatest in the life of the Laboratory. In 1934 no less than 60 different designs of ships have been tested, and the modifications of these designs which have been suggested and carried out by the Laboratory, have effected very large improvements in the resistance of a number of these vessels. Assuming that only one ship of each type is built, that each of these ships is steaming for only 200 days per year, and the life of these ships is 20 years, the net saving to the industry in coal bills alone will be £500,000.

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Notes of the Month.

THIS issue of *Discovery* is marked by a new feature, which should prove of great interest to readers. An arrangement has been entered into with the National Trust for Places of Historic Interest or Natural Beauty by which a page will be regularly devoted each month to the latest news of the work of the Trust. The National Trust is among the foremost of the organisations engaged in the promotion of the better knowledge of the countryside; our native fauna and flora as well as buildings and sites of historic and artistic importance come under its protection, as may be seen in the following extract from the National Trust Act of 1907: "The National Trust shall be established for the purposes of promoting the permanent preservation for the benefit of the nation of lands and tenements (including buildings) of beauty or historic interest and as regards lands for the preservation (so far as practicable) of their natural aspect features and animal and plant life."

* * * *

The annual report of the National Physical Laboratory, published last month, reveals an untiring continuance of the good work at Teddington; scientists and industrialists owe a greater debt than ever to the research workers of the N.P.L. The growing prosperity of the country has been reflected in the increased demand for industrial investigations at the Laboratory. This increase has been most marked in the work called for by the shipbuilding industry, and the number of

The Radio Department has continued its work for the Radio Research Board, and the Report outlines the investigations carried out on the electrical properties of the soil, over which all radio waves must travel, and of the ionosphere, from which most radio waves are returned earthward. Special attention has been given to the evidence obtained from shortwave signals from the other side of the Atlantic as to the characteristics of their travel *via* the ionosphere. The differences between the results of 1934 and 1933 are notable, and add to our knowledge of the important effects, on radio communication, of the eleven-year cycle of solar activity. The practical problems of direction-finding are closely connected with the vagaries of the waves returned from the ionosphere, and continued success has been attained in the development of direction-finders less subject to the errors produced by these waves than those hitherto available. The exploration of the ionosphere continues to reveal fresh complexities in structure and behaviour, and these are being investigated in detail in relation to seasonal and other variations with time, as well as to such phenomena as solar activity, magnetism, thunderstorms, and meteors.

* * * *

THE thirteenth meeting of the Unity History School, held at Rome by the invitation of the School of History of Science in that city, was a greater success than ever, and the fortunate members who attended the School

are full of enthusiasm, not only for the high quality and interest of the papers presented, but also for the cordial hospitality of their Italian hosts and the singular beauty of the Eternal City. In addition to the more serious fare of the meetings, plenty of opportunities were available for seeing the sights in comfort—one of the pleasantest amenities of these travelling schools—and the members, of whatever political complexion, were greatly impressed by the vigorous progress of the Italian government. Most revealing of all the expeditions was that to the new cities—Littoria and Sabaudia—in the irrigated Pontine Marshes, a brilliant piece of social reconstruction; and the Planetarium set up in the Baths of Diocletian caused many of the travellers to wonder why such an excellent adjunct to the study of astronomy could not be made available in Britain. Professor Enriques, Mr. Marvin, and Dr. Parr are to be warmly congratulated on the first-rate organisation of the School.

* * * *

Arrangements are now being made for the continuance of the Unity History Schools in conjunction with the Institute of Psychology. It is proposed to hold the 1936 meeting at Canterbury next Easter, the subject being "The Foundations of Civilisation." Enquiries may be addressed to the office of this journal.

* * * *

A New Zealand correspondent, in the *Christchurch Times*, makes interesting reference to Dr. C. Williams's article on the migration of butterflies, which appeared in the February issue of *Discovery*. Speaking of the Painted Lady butterfly, he quotes Mr. G. V. Hudson, author of "The Butterflies and Moths of New Zealand," who states: "The species occurs in the North Island and in the South Island, but is very irregular in appearance. It is abundant in some years. In other years, hardly a single individual is seen." January, February, March and April are the months favoured in the Dominion but there is no New Zealand record of caterpillars of the species. Records of the movement of this butterfly in New Zealand, with dates, directions of flight, and localities, would be of the highest importance to entomologists.

* * * *

For the eminently reasonable charge of sixpence, H.M. Stationery Office has just published a *Brief Guide to the National Museums and Galleries of London*, appropriate in this Jubilee year, when the metropolis of the Empire may expect an especially large influx of English-speaking visitors from the Dominions and the United States. The descriptions are necessarily brief to the last degree, and simply give an idea of what may

be expected to be found in the various rooms of the museums dealt with. As Lord D'Abernon states in his prefatory note, this guide is not intended as a substitute for the individual handbooks published by each institution; nor can it replace the general guides to London written as handbooks for the visitor and as reference books for the Londoner, but it is well printed and very well illustrated. It is interesting to see that the Home Office Industrial Museum is given two or three pages; its position (unknown even to most Londoners) might well have been indicated on the plan on p. 105. In several other less important respects the plans are wrong, having apparently been drawn from out-of-date models.

A Distinguished Editor.

The publishers of *Discovery* deeply regret to record the death on May 15th of Mr. Findlay Muirhead, the founder and first editor of the Blue Guides now published by Ernest Benn, Ltd. One of the foremost authorities on guide-books for travellers, he had intended to pursue a career at the Bar, but a brief experience on the staff of the *Scotsman* and on the *Encyclopædia Britannica* led him to take up an appointment with the publishing firm of Karl Baedeker in Leipzig. Eventually he became co-editor, with his brother, of the English editions of the famous German guidebooks, and served in this capacity until the association was suddenly severed by the war.

Findlay Muirhead was born in Glasgow in 1860 but was educated in Edinburgh at the Royal High School and the University, where he took his M.A. He achieved the coveted position of Latin "dux" during his last year at school, and was to the fore in the organisation of student activities at the University. His training served him well in his editorial work, for to an even more marked extent than Baedeker, the Blue Guides—which were founded in 1915—bear the mark of an original and scholarly mind. The difficulty of launching an entirely new series of guides under war-time conditions was a test which, in its successful outcome, proved his usual ability as a publisher as well as editor. In all his books Muirhead adhered to the principle of strict impartiality which he had learned at Leipzig, and it is this, perhaps more than any other feature, which has endeared his guides to so large a public both in this country and in the United States. Mr. Muirhead leaves one son, Mr. Russell Muirhead, the present Editor of *Discovery*, who follows his distinguished father in the editorship of the guides. For some years both names have appeared on the title page as joint-authors of the series.

J.A.B.

New Biblical Texts.

By Sir Frederic G. Kenyon, K.C.B.

The acquisition by the British Museum of the Codex Sinaiticus, followed by the recent discovery of some fragmentary papyri of very early date containing a new version of the life of Jesus Christ, has given a new stimulus to the examination of biblical texts. Sir Frederic Kenyon here summarises the recent discoveries and the important works of textual criticism to which they have given rise.

LAST April four volumes* were published almost simultaneously which are of great interest to Biblical students, and which deserve to be brought to the notice of readers of *Discovery*. One is a German edition of the Greek Old Testament (Septuagint); the second is the first instalment of a new English critical edition of the Greek New Testament; the third, the most generally interesting of all, is an edition of some fragments of a wholly unknown Gospel of very early date; and the fourth is a very substantial addition to one of the Chester Beatty papyri.

Professor Rahlfs' edition of the Greek Old Testament is a great single-handed achievement by the leading Septuagint scholar in Germany. He, with his colleagues of the Göttingen Septuagint Commission, has long been engaged on the preparation of a full critical edition of the Septuagint, but the war and the subsequent economic conditions have made its production impracticable for the present, and this smaller edition has been undertaken as its substitute. It therefore compares with the smaller Cambridge critical edition produced by Dr. Swete in 1887-1894, rather than with the large edition now in course of production by Dr. A. E. Brooke and Mr. N. McLean; but with this difference, that whereas Swete prints without revision the text of the oldest MS. (the Codex Vaticanus where it is extant, the Sinaiticus or Alexandrinus where it is not) with an apparatus recording the variants of the principal uncial MSS., Rahlfs constructs a new text. As its basis he uses the three manuscripts just mentioned, and they are the only MSS. included in his preliminary list of authorities and whose variants are regularly recorded in his apparatus; but in fact he occasionally notes the readings of other authorities, such as the Codex Bezae Cantabrigiae (M), the Bestin papyrus of Genesis (911), the Washington Codex of Deuteronomy (W), the Codex Marchalianus

of the Prophets (Q), and the texts, where identifiable, of the recensions of Origen and Lucian. Thus, while the Cambridge editors of both the small and the large edition have confined themselves to the collection of materials, the edition of Rahlfs is the first attempt to construct a revised text on the basis of these materials. As such, it will be of great service to students, and will probably hold its place as the best available text of the Septuagint for a long time.

An Interesting Comparison.

It is unfortunate that the Chester Beatty papyri (of which an account was given in *Discovery* in November, 1933) could not be published in time to be utilised by Professor Rahlfs. They would have been particularly useful in Genesis, where Vaticanus and Sinaiticus are almost wholly wanting, and where the two Chester Beatty MSS. (known as 961 and 962) supply the oldest extant text of nearly the whole book. It is interesting to compare them with the text printed by Rahlfs. In chapter xxiv, which is preserved in both Chester Beatty MSS. (and partly also in the Berlin papyrus), in a total of 76 passages, Rahlfs, who has had to depend on the Alexandrinus (A) and 911, follows A in 52 instances and deserts it in 24; in 13 of these 24 readings, at least two of the papyri support his preference, while in three cases the rejected reading of A is supported by two papyri and in five by one. Altogether, two or more of the papyri are found differing from Rahlfs' reading in 27 instances, while they support it in 26; the Chester Beatty papyri agree in differing from him 24 times, and in supporting him in 14, while in 31 cases their testimony is divided. In Numbers and Deuteronomy, where both Vaticanus and Alexandrinus are available, Rahlfs generally follows the former; but where he prefers the A reading, it is remarkable how often his choice is confirmed by the Chester Beatty papyrus (963), which, it may be recalled, is of exceptionally early date, having been written in the first half of the second century. Thus, in the parts of Numbers preserved in the papyrus, Rahlfs follows B against A 116 times, and A against B 43 times; and the papyrus confirms his choice 96 and 32 times respectively. Since the papyrus as a rule supports B rather than A in this book, its evidence where it agrees with Rahlfs in supporting A may be

* *Septuaginta, id est Vetus Testamentum Graece juxta LXX interpretes*, edidit ALFRED RAHLFS (Stuttgart, Privilegierte Württembergische Bibelanstalt, 1935). 2 vols. RM. 12.

Novum Testamentum Graece secundum textum Westcott-Hortianum: Evangelium secundum Marcum cum apparatu critico novo plenissimo, edidit S. C. E. LEGG, A.M. (Oxford, Clarendon Press, 1935). 21s.

Fragments of an Unknown Gospel and other early Christian Papyri, edited by H. I. BELL and T. C. SKEAT. (London, British Museum, 1935.) 4s.

A Third Century Papyrus Codex of the Epistles of St. Paul. Edited by H. A. SANDERS. (Ann Arbor, 1935). \$3.00.

taken as decisive. Similarly in the extant parts of Deuteronomy, where Rahlfs follows B against A in 199 cases, and A against B in 118, the papyrus agrees with him in 115 and 97 cases respectively. In this book, it may be observed, the character of the papyrus changes, since it is markedly more often in agreement with A than with B.

Daniel is another book for which the evidence of the Chester Beatty papyrus (968) would have been particularly useful. Before its discovery, the original Septuagint version was known only in a single Greek MS., all others giving the revision of Theodotion, which corresponds more closely with the Masoretic Hebrew. Rahlfs prints both versions, but for the LXX has to depend on the Chigi MS. alone and a Syriac translation. The Chester Beatty papyrus, so far as it is extant (ch. iii. 72-viii. 27) provides far earlier evidence for it, and a summary collation shows that in 75 places (not counting obvious scribal errors) it differs from the text of Rahlfs.



The Chester Beatty papyrus of the Apocalypse written probably in the second half of the third century.

Most of these variants are of small importance: what is important is that it shows no trace of Hexaplaric influence, *i.e.*, of words introduced by Origen from the Hebrew. It may therefore be regarded as a good representation of the original LXX text.

These comparisons with the Chester Beatty papyrus show that finality has not yet been reached, but they in no way detract from the merit of Rahlfs' work; and the Württemberg Bibelanstalt deserves the thanks of students for adding (at an exceedingly moderate price) this edition of the Septuagint to their already well-known editions of the Hebrew Old Testament and of the Greek and Latin New Testament.

New Testament Revision.

Mr. Legg's St. Mark is the first instalment of a much greater undertaking. Hitherto the best collation of the textual evidence for the Greek New Testament has been the edition produced by Tischendorf in 1869-72. The later edition of von Soden, though containing the evidence of many more MSS., is made difficult of use by his unfortunate decision to change the nomenclature of all the MSS., including the most familiar, and stie more by his giving the evidence, not of the individual MSS., but of groups of MSS.; and since the groups are by no means always constant, it often becomes very difficult to ascertain what the actual support of a given reading is. Accordingly a British committee, under the chairmanship of the Bishop of Gloucester, decided to undertake what is in effect a new Tischendorf, brought up to date by revision and by the inclusion of many important authorities which have come to light in the course of the last 60 years. The most notable of these are the Sinaitic Syriac, the Washington Codex of the Gospels (W), the Koridethi Codex of the Gospels (Θ), the Sahidic Coptic (of which only a few fragments were known to Tischendorf), and the Chester Beatty papyrus of portions of the Gospels and Acts. In all 58 uncials are included in the list of authorities (many of them only fragments). Of the minuscules 19 are fully collated, while of many more particular readings are given. The evidence also of the Latin, Syriac, Coptic, Georgian, Ethiopic, and Armenian versions is fully stated, and readings from 39 of the early Fathers. Mr. Legg, who has carried through this work single-handed, is an extremely careful worker, and, so far as can be judged on a short inspection, has executed his task admirably. The Gospel of St. Mark was chosen as the first portion to be produced, both because it is the earliest of the Gospels, and because it is the one which offers the most important problems to the textual critic. The production of this fasciculus will greatly facilitate the attack on the great problem of the character and relative

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value of the main textual groups which pass under the names of Neutral, Western, and Caesarean, on which no final verdict has yet been reached. It is greatly to be hoped that sufficient support will be forthcoming to enable the work to be carried forward; and future fasciculi will benefit by the criticisms which the present publication will no doubt elicit.

The third of the volumes before us is far more novel, and will appeal not only to scholars but to the general public. Among a group of miscellaneous papyri recently acquired by the British Museum, the scholars of the Manuscript Department came upon some fragments which they speedily recognised as containing a hitherto unknown narrative of the life of our Lord. The handwriting showed them to be of very early date; papyrological experts are agreed in saying that they cannot be later (and may be earlier) than about the middle of the second century. They are thus about a century earlier than the Chester Beatty papyrus of the canonical Gospels, and two centuries earlier than the Vaticanus and Sinaiticus; and the text they contain is a new Gospel. Unfortunately there is not much of it. There are portions of three leaves of a papyrus codex, but even these are much mutilated, and of the third leaf there are only a few letters. All that there is has been edited by Dr. Bell (whose reputation as a papyrologist is second to none), with the assistance of Mr. Skeat, in a volume which (besides being amazingly cheap) is a model of such scholarship, containing an exact transcript, a restored text, translation, palaeographic and exegetical commentary, and a full photographic facsimile. The commentary is as full as a first commentary can be, and scrupulously careful and moderate in statement. Scholars have before them all that they could ask for to enable them to form a judgment on the new text.

A New Gospel Text.

What then is its nature? We have before us in these fragments four episodes in the life of our Lord, of which three have manifest relations with incidents recorded in the canonical Gospels, while the fourth is new. The first relates a controversy with the "lawyers" and "rulers of the people," ending in an attempted stoning. In this there are close parallels with the Fourth Gospel; e.g., "Search the Scriptures, in which ye think that ye have life; these are they which bear witness of me" (= John v. 39); "Think not that I came to accuse you to my Father; there is one that accuseth you, even Moses, on whom ye have set your hope" (= John v. 45); "And when they said, we know well that God spake unto Moses, but as for Thee, we know not whence Thou art, Jesus answered and said unto them, Now is



"Egerton Papyrus No. 2," the three fragmentary leaves of the codex with the new Gospel text.

(British Museum Photograph.)

your unbelief accused. . . ." (cf. John ix. 29); "And the rulers sought to lay hands on him that they might take him and deliver him to the multitude; and they could not take him, because the hour of his betrayal was not yet come" (cf. John vii. 30); "But he, going out through the midst of them, departed from them" (cf. John x. 39, Luke iv. 30). The wording is substantially the same as in St. John, but the phrases appear in different parts of St. John, and the grouping is different.

This is followed immediately by the healing of a leper, which is manifestly the same incident as is recorded in Mark i. 40-42, and the parallel passages in Matthew and Luke; but the wording is different. In particular, it begins with a new detail: "And behold there cometh unto Him a leper, and saith, Rabbi Jesus, journeying with lepers and eating with them in the inn, I myself also became a leper. If therefore Thou wilt, I am made clean." The healing is apparently followed by an instruction to show himself to the priests, as in the Synoptists; but the first fragment breaks off here.

The second leaf contains on one side a version of the incident of the tribute-money, recorded by the three Synoptists, but narrated very differently, and with phrases which occur in different contexts in the canonical Gospels; e.g., "Is it lawful to render unto kings that which pertaineth to their rule: shall we render unto them or not?" (cf. Mark xii. 14); "But Jesus, knowing their thought, being moved with indignation, said unto them, why call ye me with your mouth Master, when ye hear not what I say?" (cf. Luke vi. 46); "Well did Isaiah prophesy of you," etc. (= Mark vii. 6,7).

The fourth incident, which is on the other side of this leaf, appears to be quite new, but the papyrus is so much mutilated that its exact nature is unfortunately obscure. What can be deciphered appears to run as follows: "... its weight unweighed . . . And when they were perplexed at his strange question, Jesus, as He walked, stood still on the edge of the river Jordan, and stretching forth His right hand He (took water?) and sprinkled it upon the . . . And then . . . it sent forth fruit. . . ." Conjecture may restore this tantalising passage, but so far it has defeated all efforts.

The Date of St. John's Gospel.

Scholars have now to determine the question, was the author of this Gospel writing with the canonical Gospels (St. John as well as the Synoptists) before him? Or (since the parallelism of phrases is too great for absolute independence) was he using some of the materials on which they drew? Or was this Gospel one of those materials? The date of the papyrus proves that the Gospel is of early date, probably of the first century. The simplicity of its style is quite in accordance with that of the Synoptists; it has none of the childishness or exaggeration or mysticism or tendentiousness which characterise the apocryphal gospels hitherto known. The phrases which find their parallel in the Fourth Gospel are not particularly Johannine in style, so that they might have come from sources used by the Evangelist, not from the Gospel itself. Space will not admit of a full discussion of the problem here; but, if the writer was using the four Gospels, he becomes a decisive witness for the relatively early date of St. John; the Fourth Gospel cannot be later than the first years of the second century at latest. If, on the other hand, he was not using them (and personally I find it very difficult to understand how a mere compiler from the four Gospels could have produced these results), then we have here one of those many other narratives of our Lord's life to which St. Luke alludes in the preface to his Gospel. The interest of such a discovery is obvious.

Of the other texts contained in this volume it must suffice to say that they comprise (1) some small frag-

ments of a Gospel commentary, of the early 3rd century, too early apparently for Origen, but just possibly by Irenæus or a Gnostic commentator; (2) a leaf of a 3rd century codex of II Chronicles (xxiv. 17-27); and (3) a leaf from a liturgical work of the 4th or 5th century. These are primarily edited by Mr. Skeat; but Dr. Bell has collaborated, as has Mr. H. J. M. Milne both in these and in the new Gospel.

New Chester Beatty Papyri.

Finally, a considerable addition has to be reported to the great Chester Beatty find of Biblical papyri. Readers of *Discovery* will remember that among the original discovery there were ten leaves of a manuscript of the Pauline Epistles, containing portions of the Epistles to the Romans, Colossians, Philippians and first Thessalonians. These were published in the third fascicule of the *Chester Beatty Biblical Papyri*. The numbering of the pages showed that something over seventy leaves were missing from the middle of the codex, which, like some other early papyrus codices, was formed of a single large quire. Since the publication of these ten leaves, it has become known that many of the missing leaves are in existence, and it was presently announced that thirty of them had been acquired by the University of Michigan. These have now been published by Professor H. A. Sanders, with a full introduction. They bear the page numbers 30-33, 36-55, 58, 59, 78, 79, 136-167, and contain portions of Romans, Hebrews, 1 and 2 Corinthians, Ephesians (complete) and Galatians, in that order. It will be observed that they confirm the conjecture, made in my previous article and in the edition of the Chester Beatty leaves, that the missing portion included Hebrews. This follows immediately after Romans,—an almost unprecedented order, being found only in a single minuscule MS. Whether the complete MS. contained Philemon, and also (as Professor Sanders is inclined to think) the epistles to Timothy in an abbreviated form, remains uncertain; the latter conjecture seems to me improbable. The Michigan leaves, however, add very materially to our knowledge of the MS., which, being of the third century and probably very early in it (Professor Wilcken, the leading papyrologist alive, would even place it "about A.D. 200"), must be regarded as the principal authority for the text of the Epistles. One striking detail is that the final verses, or doxology, of Romans (xvi. 25-27), are placed at the end of ch. xv., which goes far towards proving (what has been previously conjectured) that ch. xvi was originally a separate short letter introducing Phœbe, probably to the Church at Ephesus. Some MSS. place the doxology at the end of ch. xiv., which led Gregory to suppose that ch. xv. was

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also a separate letter, but to the Romans. This supposition now appears unnecessary.

It is now possible to announce that Mr. Chester Beatty has acquired 46 additional leaves of this precious MS., so that we now possess 86 leaves out of an original 104. The new Chester Beatty leaves contain portions of Romans, Hebrews, 1 and 2 Corinthians, Galatians, Philippians, and Colossians, so that we now have (apart from local mutilations) almost the whole MS., except the seven first and seven last leaves. It is hoped soon, through the kind co-operation of the Michigan

authorities, to publish a complete edition of the whole. Meanwhile students of the Pauline Epistles have already something substantial to work upon. The Michigan leaves confirm the conclusions already drawn from the Chester Beatty leaves as to the general character of the text of the MS., but strengthen and greatly amplify them, besides adding much information as to particular readings. Professor Sanders deserves warm thanks and congratulations for his edition, which is usefully arranged and handsomely printed, with three plates of facsimiles.

The British Canning Industry.

By Ronald S. Potter.

Food preserved in tins—"canned" food—has become a commonplace of the dining-table. Some idea of the steps by which this convenience became possible and of the research which has led to the complete safety of the modern canned product is of great interest, especially in view of the progress which this industry has lately made in Britain.

WITHIN the last twenty years the canning industry* has risen, in this country, from comparative insignificance to a prominence which British agriculturalists trust will be lasting. But canning is by no means new, since it dates back some 125 years. It would be difficult to ascribe to any one individual the distinction of having founded the industry, in spite of the fact that claimants are many. Much pioneer work in military, political, and economic matters emanated from the French Government at the end of the 18th century, but it is not generally known that the discovery which gave birth to the canning industry was a result of an effort to solve a problem of national importance. In 1795 a prize of 12,000 francs was offered to the person who evolved the most practical method of preserving food for the army and navy.

In April, 1804, Nicolas Appert, a Frenchman who had had a wide and varied experience in the "art" of preserving and preparing foods, discovered a process of maintaining foods in sound condition for indefinite periods by heating them in sealed glass jars. In 1810 the method was perfected, and although Appert

was not a scientist his technique was such that even today, after 125 years, the original method is still used for some foods, notably fruits. Appert did not understand the reason for his success, which fact makes the precision of his methods, as evidenced by the testimony of time, more remarkable still. Appert's process consisted briefly of packing the food into glass jars, loosely corked, and heating them in a bath of hot water at 190° to 212° F. for varying periods depending on the nature of the food under treatment; finally the corks were pressed in tightly. The discovery was received in France with great enthusiasm, and Gay-Lussac, one of the foremost French chemists, was given the task of examining Appert's method with a view to elucidating the mystery of the cause of his success. The results of Gay-Lussac's researches were published in a Government report, and he attributed to the absence of air or oxygen the fact that spoilage of the food did not take place; he considered that spoilage was due to a series of oxidation reactions which did not proceed when oxygen was excluded.

There is every reason to suppose that Appert was the real discoverer of the process which we now term canning, but it is interesting to note that at about the same time—in 1807 and 1810—publicity was given in England to processes of preserving food "without the use of sugar." These processes, one of which was patented, were so similar to that of Appert as to suggest that they were derived from his method. In one of them, however, there was one important difference: that tinsplate cans were mentioned as being suitable containers. It is also probable that an Englishman was the first to introduce canning into America about

*HOME PRODUCTION OF CANNED GOODS IN THE UNITED KINGDOM.

	1930	1924
Fruit preserved without sugar:		
tinned or bottled	£373,000	£219,000
Vegetables, dried, canned, and bottled	£768,000	£164,000

From the Final Report of the Fourth Census of Production (1930), Part III, published by H.M. Stationary Office, price 8s. 6d.

1820, but it was again from France that the next important development came. Gay-Lussac's purely chemical theory of the process was disproved by the work of Pasteur, who put forward an explanation based on bacteriology. He showed that, except in so far as air was the medium by which infection in the form of yeasts, moulds, or bacteria may be distributed, it was not the cause of spoilage in preserved foods, as was supposed by Gay-Lussac. Pasteur's work was the scientific foundation of the canning industry.

It has been already seen that the canning industry may be truly said to have arisen as a result of the impetus of war. In the same way many instances of the effect of subsequent wars on its development are to be found. In America the progress of the industry since 1820 had been relatively slow until the outbreak of Civil War, during which canned food formed an important part of the soldiers' diet. In our own country the Great War undoubtedly had a great influence in fostering the canning of home-grown foods, and enormous increases in the home production of canned fruits, vegetables, and meats, were occasioned.

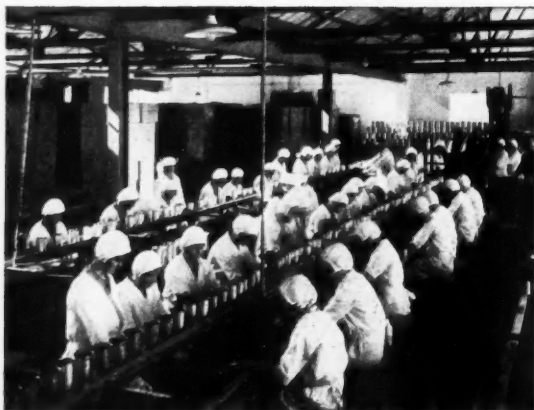
Important though the effect of wars has been throughout, it is not intended to convey that the impetus so gained would have had such a lasting effect had not other factors played an important part. From very early times man has always tried to extend the use of the foods he needs and likes best beyond their normal seasons, as evidenced by the very early practices of curing, salting, and drying. In more modern times, no doubt, the canning industry has developed as a result of the prejudice against canned foods having been greatly reduced. Also the desire to eat foods which are either out of season, or are only grown in other climates, has increased in recent years. Certain fresh fruits, particu-

larly grape-fruit and pineapple, which are normally transported to this country in an under-ripe condition, and are allowed to ripen on the way, are noticeably inferior in flavour to the corresponding canned variety. The reason for this is that in the case of the latter the fruit is fully sun-ripened and canned immediately after gathering.

The War on Bacteria.

Although Appert's technique was so perfect as to enable him to preserve successfully many different types of food, early canners experienced very large losses due to a complete ignorance of the scientific principles underlying the process, and to faulty containers and machinery. As scientific knowledge increased so improvements in the containers and machinery resulted, and as a consequence "blown" cans are rarely seen to-day. It would be impossible here to give more than an outline of a few of the more important scientific discoveries that have placed the canning industry on a sound and safe basis. Passing over the more general bacteriological work of such men as Koch, Pasteur, and Lister, we find that the first practical applications of bacteriology to canning took place in the U.S.A., Russell isolating a bacillus which had caused spoilage in canned peas. Since this time (1895) an immense amount of work has been done in America and latterly in this country on spoilage organisms. Many varieties have been isolated, studied carefully, and in most cases successful treatments against their activities have been prescribed. One of the most interesting cases of the application of bacteriology to the canning industry concerns a group of bacteria known as Thermophyles. These organisms, are capable not only of causing the swelling of the can, but can also give rise to a souring, or other change, in the flavour of the contents of outwardly sound cans. This type of spoilage is most frequently met with in canned corn and peas, and, until recently, its ravages often caused enormous financial losses to canners on account of the sudden attack to which the pack is subject. The peculiarity of these bacteria is that they do not develop at ordinary temperatures but require about 120° to 150° F., and they can withstand considerable heat treatment without destruction. They will not grow on the ordinary laboratory culture media, and for this reason were difficult to isolate and study until special culture methods were used. By avoiding the particular conditions which are favourable to their development in the factory this form of spoilage has become much less prominent.

Another important and interesting discovery was made in England by Savidge. Until his work it was



General view of the sorting and filling tables in a fruit cannery, showing can conveyors.

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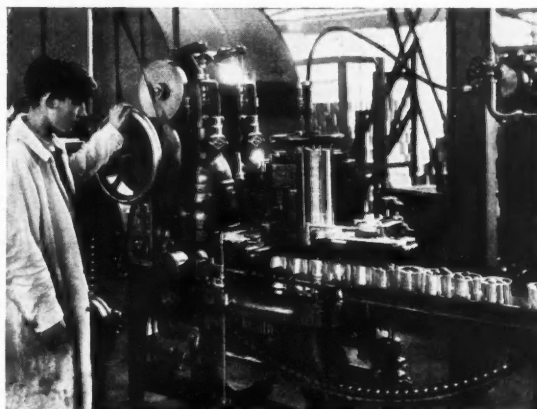
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generally assumed that all canned goods which remained preserved for indefinite periods must be sterile, but Savidge showed that this was by no means the case, and in fact rather the exception. Even to-day it is not generally realised that canned goods which, under normal conditions, will keep indefinitely, may contain a number of living organisms or their spores. The fact that they do not develop and cause spoilage is probably explained by a combination of circumstances. The environment may not be suitable for the particular organisms present, or they may have been so weakened by the heat treatment that they will develop only under ideal conditions of storage and nutrition.

With a better understanding of the causes of spoilage, and a growing demand for canned goods, improvements in the containers and machinery naturally followed. From an entirely hand-made article with heavily soldered side seams and ends the tin can has gradually developed into the present day open-top or "sanitary" can, with the ends rolled on by machine, and made airtight by a rubber gasket, with the result that a minimum of solder is exposed to the action of the contents.

Improved Commercial Processes.

It has been mentioned above that all Appert's processing was carried out at 190° to 212° F., and a separate time was specified for each food. Whilst fruit required only an hour or less, meat, fish, and vegetables required about six times as long. The time required for preservation has since been shown to depend chiefly on the active acidity. The higher the acidity the less the time necessary, and vice versa. This six-hour process was a great drawback to factory operation, and it is not surprising to find that canners directed their attention to obviating this. In 1861 it was found that by raising the temperature above boiling point the time required to sterilise vegetables, meats, and fish could be reduced considerably. To do this commercially a salt—calcium chloride—was added to the water in the bath in sufficient amount to raise the boiling point to 240° F. In this way the process was reduced to an hour or less. In 1874 Shriver introduced the closed kettle method for processing, a temperature of 240° F. being reached by means of superheated steam, or steam under pressure. This method was the forerunner of retorts, which are in use at the present day. Recently, however, these have been largely replaced by continuous cookers, which obviate the laborious and costly process of loading and unloading retorts. In addition to machines which are concerned with what might be termed the process side of the operation of canning food, a number of ingenious devices have been evolved for preparing and grading



Automatic can-closing machine.

the raw materials. Such machines include those for shelling peas, removing the hairs from gooseberries, and taking the stalks off black currants.

In this way we have gradually reached the present day conditions of factory practice, and it is not surprising to find that canned goods now occupy an important place in almost every household. Volumes have been written on the food value of such goods, and it has been conclusively proved that in most cases the vitamin content is equal to that of the corresponding fresh food, and in certain cases it has been said to be even greater. We can safely say, at any rate, that the vitamin value of most canned products is greater than that of the same products cooked under normal household conditions.

An Encouraging Report.

The Annual Report of the John Benn Hostel which was submitted to the seventh Annual Meeting of the East End Hostels Association on May 16th was a record of progress all along the line. The Hostel was started in memory of the late Sir John Benn, the founder of Benn Brothers, Limited, publishers of *Discovery*. The purpose of the Hostel is to provide a home for eighty boys between fourteen and eighteen years of age, who would otherwise be homeless.

The Report stated that unemployment among the boys was almost non-existent. The financial position of the Hostel, to which the boys contributed a specified portion of their earnings, was a little happier than in earlier days, though the Council had still to rely on a great number of friends to make ends meet. The Annual Appeal this year is being made by Sir Ernest Benn, the President of the Association, who will preside at the Annual Banquet which will be held in Stationers' Hall, London, on June 20th.

Art in African Literature.

By Captain W. Hichens.

Late of the Intelligence and Political Services, East Africa.

The Swahili illuminated manuscripts described and illustrated below will come as a surprise to the great majority of readers. That savagery is universal among the African peoples is too often taken for granted, but this article, following earlier contributions to "Discovery" by Dr. Alice Werner, shows that the truth is far otherwise.

It has been said so often that the African native has no written literature, that a bibliophile, if asked whether he possessed some of the rarer manuscripts of the African native poets, might well retort that such things do not exist. The archives of the British Museum would almost support the denial since they possess only one, and that an incomplete example, of a very considerable written literature of great beauty, often of high philosophic tone, the product over many centuries of the African native poets of the Swahili people on the East African coast.

It consists of a large body of poetry and prose dealing with historical, religious, philosophical, romantic, erotic, and domestic themes, alchemy, witchcraft, myth, and malediction. Some of it is very ancient, written in an archaic and now obsolete form of the Swahili language,

comparable with the language of early English poetry, and it can be read only by the *walimu*, the learned, who have studied it. Some is of more modern form, in the nature of our Renaissance literature; and more still is quite definitely modern and comprises love-ballads, poems on passing events, and effusions of an eulogistic or, often, highly libellous and defamatory nature addressed to individuals, and of amorous billets-doux in which African sensuality displays a licence not always poetic for the sake of poesy.

The whole of this literature exists in the form of manuscripts. The older and rarer copies are treasured by the better class Swahili families, who are mainly literate Moslems of some breeding, the aristocracy of the native ports who, though now often in humble circumstances, were a century ago the royalty and court of the Lamu and Mombasan sultanates. Copies of these old and of the more modern manuscripts are made by professional native scribes, who are usually professional *washairi*, poets, or *malenga*, minstrels, while these latter do also a brisk business in ballads, eulogies, love-letters, and scandalous letters, written especially to the orders of native clients.

The manuscripts are written in an adapted form of Arabic character. The whole of Swahili writing owes its inception to the culture brought to the East African coast by Persian and Arab merchant-venturers who, long ago—certainly as far back as 200 A.D. and probably much earlier—established trading ports at Lamu, Mombasa, Kilwa, and elsewhere on the littoral of what are now Kenya, Tanganyika, and Zanzibar. These early "colonists" found there a Bantu people who spoke a barbarous tongue, ill-adapted to the niceties of Islam and lacking any written alphabet for the urgencies of the slave, gold, and ivory trades. The Arabs thus imposed upon the Bantu a host of Arabic words, and introduced, for social, trade, and religious convenience, the Arabic script.

It is not an ideal script for Swahili literature, since the Arabic alphabet lacks many vocal and consonantal sounds very frequently occurring in Swahili. For instance, Arabic has no *p* and makes no provision for the sound *mb*, so that a Swahili scribe writing a word such as *pembe* (an ivory trumpet, frequently mentioned in poetry) is driven to write *بب*, which also reads *bibi*



The first page, with illuminated title, of "The History of Liongo," the adventures of the legendary hero of the Swahili.

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(mistress of the household), a fact which renders the deciphering of Swahili manuscripts a somewhat perplexing undertaking until this eccentricity is mastered. But what the script may lack in orthographical precision is more than counterbalanced by its grace, balance, and beauty as displayed in a well-written manuscript, to the symmetry of which the line-endings of Swahili poetry lend an additional grace. The usual form of stanza consists of four short lines, written as one long line, without punctuation marks, but divided into four parts by little heart-shaped marks called *zilu*, which are outlined in black ink and centred with scarlet; and these alone give a precision and balance to the page. The final words of the fourth lines throughout the piece, however, invariably carry the same rhyme, often in the common Swahili terminal—*ya*, which carries the Arabic flourish *l* as a column-ending throughout the entire manuscript. The better professional scribes take great care over the precision of these line endings with the express object that the piece should "rhyme to the eye" as well as to the ear.

The better manuscripts, and quite frequently love-letters and eulogistic ballads of modern production, are illuminated with borders and title-pieces, which reflect in simple but vigorous designs and vivid colours a primitive virility in Bantu art applied to the Arab form, and which combine with the grace of the script to produce manuscripts of considerable charm and beauty.

Scrolls and formal leaf patterns are commonly used, either in simple form or as part of a motif of heart, lozenge, and shield-shaped designs with open centres in which the title of the piece is generally written in a manner allowing it to form part of the decorative scheme. Borders of repeat scrolls of leaves are popular, as also are chequerings. The borders are often inlined with scallopings and outlined with two or more bands of contrasting colours set to the extreme edges of the manuscript somewhat in the style of some modern business notepapers.

Not infrequently the Bantu element comes to the surface in the shape of some vivid, huge, quite mythical, and distinctly impressionistic flower, exotic, imbued with an insidious subtlety peculiarly African. At other times flowers used as headpiece ornaments to eulogistic letters are as innocent as any that Mr. Nevinson might pluck at gloaming from a Hampshire hedgerow.

The colours principally employed are red, green, yellow, ochre, and occasionally blue, with supporting contrasts in buff, orange, and magenta. Formerly the scribes employed natural earths and mineral and vegetable pigments of kinds common to the Oriental palette, the composition of which affords an interesting study. To some extent these old pigments are still



Buraki, the winged "horse" on which the Prophet Muhammad is related to have ascended to Heaven: drawn by Muhammad Abubakar Kijuma 'l-Bakariyyi.

used, but easy access to manufactured inks and colours has rendered the use of the old pigments in most cases a too-exacting nicety for modern work.

In some inks, however, resins, cuttle-sepia, powdered nacre, and other substances appear still to be used, and the script of the older manuscripts is often vividly fluorescent with dazzling, sparkling particles when examined in artificial light.

Some of the older manuscripts are found in scroll, others in book form, written upon a long-foolscap, lengthwise on, and sewn into a goatskin or sheepskin flapped cover. The more modern manuscripts are written either on single sheets or bookwise, according to their length. The paper is sometimes embossed with vertical and horizontal lines (the former to divide the lines of the stanzas in poetry), made by rubbing the paper upon a grooved board. The paper is usually of good quality and the older MSS., were written with a reed pen. The older scribes were emphatic upon the quality of their materials and scripts are often prefaced with the injunction:—

"Give me paper and a reed pen and good black ink—which have been carefully selected."

To the student and collector this field of Swahili

literature offers much unexplored ground, both for the collection of exotic manuscripts as such and for the interest of the literature itself. A very considerable body of rare and ancient manuscript exists as yet in the possession of the Swahili of the coast, but with the march of commerce and the rise of a new "educated and civilised" generation of Africans, little thought may be expected to be given to its preservation until the novelty of the new régime has staled. Then, as has so often occurred in Europe, the loss of the old literary culture will be clamorously deplored.

So far, few collections of these African manuscripts appear to exist, apart from one or two in the hands of scholars, a few in the archives of the School of Oriental

denied and the extent of which is as yet only glimpsed.

The short bibliography appended will afford some guidance to collectors and students alike who may feel lured to explore an interesting field, the one to enrich his shelves with manuscripts rare and beautiful and the other to browse in a literary field where any flower of prose or poetry may well prove to be a veritable desert rose.

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A New Technique.

Mental-physical unity is the basis of the system of education founded some years ago by Mr. F. Matthias Alexander, and now carried on by him at Penhill, Bexley, Kent. A slim volume, entitled *A New Technique* (price 2s.), aims at making the principles of the work as widely known as possible in education circles, and some of the methods employed should be of interest to readers of *Discovery*. The main contention is that educational training should be based on the study of the use and functioning of the human organism as a whole, and that the rigid separation of "mental" from "physical" activities is rarely justified. Other authorities have recently come forward to advocate the education of the "whole child," but many of these still use such terms as "culture of the mind," "physical health," "culture of the body," as if the working of the mental-physical mechanisms could be separated in practice. What is more, it would appear from the educational procedures adopted that the attempt is still being made to treat the child as if the working of special parts, such as hands, arms, eyes, organs of speech, legs, could be dealt with independently of the working of the organism as a whole.

The fundamental shortcoming in this manner of teaching is that the child may be called upon to carry out an instruction or exercise involving an unfamiliar use of the mechanisms, without any attempt being made to find out first if the sensory mechanisms by means of which it is guided in carrying out any activity are working reliably.

Mr. Alexander's technique of education has been especially successful with pupils, both children and adults, whose sensory mechanisms are working unreliably, and, in order to enable him to carry out his programme without heavy personal expense, the "F. Matthias Alexander Trust Fund" has been formed and placed in the care of a distinguished body of trustees.



A typical eulogistic letter written by a Swahili scribe and addressed by him to a European friend on the event of a journey to England.

Studies, in London, a small collection at Hamburg University, with isolated copies in Paris and in missionary society and institutional libraries. Very few have as yet been translated and published, but those which have instance the richness and diversity of an indigenous African literature, the very existence of which is often

The Future of British Mammals.

By Eric Hardy, F.Z.S.

Following his forecast of the future of British birds, published in DISCOVERY last October, Mr. Hardy deals with British mammals in the same way. The changing countryside is more hostile to mammals than to birds, and the beautiful pine-marten, among other less conspicuous native animals, is threatened with extinction before long.

IN the wild life of the British Isles, the mammals seem less able to fit themselves into the changing conditions of the countryside than do the birds, but, while there is no doubt that the present century will probably see a further diminution in the mammal life of our countryside, certain rare animals like the polecat and wild cat are not nearly so close to extinction in Britain as many people would have us believe. There are enough polecats in Wales and enough wild cats in Scotland to last out at least another twenty years, and of our marine mammals, the grey seal is well holding its own on the west, despite some thoughtless persecution.

Since Millais, Thorburn, and Johnston wrote their invaluable works on British mammals, there has been something of an alteration in the prospects of our quadrupeds, due partly to the decrease in gamekeepers through economy demands and the breaking up of the big estates (especially during the war years when most gamekeepers were away on active service). The mammals usually retreat before advancing suburbia, with the possible exception of squirrels and bats in some places, which will take to life amid human habitations if a park is available. The busy highways intersecting the countryside are another handicap, as is shown by the frequency of dead hedgehogs, shrews, and sometimes badgers and otters on the roadside, victims of the fast car.

Our British bats are in no great danger of reduction and the pipistrelle, whiskered, and noctule bats will probably be as common at the end of the century as they are now, with the success of the present propaganda for more trees in the countryside. Stoat and weasel would undoubtedly treble their numbers if game-rearing ceased, but the future of the polecat is another matter. In the well-wooded parts of central Wales, polecats are still unexpectedly numerous and there are plenty in the Lake District, at least one pair breeding as far south as the Hodder, while in 1934 a polecat was caught by a terrier on the outskirts of Preston, and in 1932 another was trapped at Little Crosby, on the borders of Liverpool, the skull of which was exhibited by the writer before the Liverpool Naturalists' Field Club. Three years ago a Llangollen gamekeeper declared he had caught enough polecats to make a fur wrap for his wife; in 1927 three were trapped at Aberdovey;



The beech-marten, shown here, is probably quite extinct in Britain. Its cousin, the pine-marten, is threatened with speedy extermination.

[Photograph by Douglas English]

while in 1934 a dog-polecat was caught six miles from the centre of Cardiff and sent to the National Museum of Wales. In 1930, a rabbit-catcher in Ross-shire found three polecats in his traps one morning, and at first thought they were ferrets, but later the captures were proved to be truly wild. Many of the polecat records undoubtedly refer to escaped poachers' ferrets or crosses between ferrets and polecats, but wild polecats are certainly still numerous in Scotland and Wales, with a preference for the latter country, where 250 have been taken in the past three years. The pine-marten is certainly facing extinction in this country; some still exist in Scotland but only a few linger on in Wales, in Merionethshire and Carnarvonshire, probably not half a dozen pair in all, and probably if it were not for the reduction of gamekeepers during the war, the pine-marten would be extinct by now. A pine-marten was trapped in the woods close to Worsley Hall, in the Lancashire Lakeland, in August, 1919. One was watched on the hills at Abergele, in 1929, one shot at Barmouth in 1927, and another trapped at Llanbedr in 1926.

Like some of the polecats recorded, the specimens of wild cat reported from Scotland are frequently accused of being crosses with domestic animals run wild, but Scottish naturalists are of the opinion that the status of the true wild cat has been considerably underestimated in recent years and that this cat has, in many

parts, increased since the war. It may surprise many to hear that over 300 wild cats are reputed upon reliable authority to be trapped annually in Central Inverness-shire alone. The wild cat is now in no immediate danger of extinction in Scotland, though so reduced at the beginning of the century. During the war it regained its numbers in a remarkable way and is now back in nearly all its former Highland haunts. Gamekeepers in winter in Ross-shire often come across wild-cat tracks in the snow when rabbit-trapping, and from time to time wild cats are run over on the roads. At the end of 1933 the head keeper at Kingussie, in Badenoch, caught one of the finest known specimens of the true wild cat, a beautiful tom, $38\frac{1}{2}$ in. long and $15\frac{1}{2}$ in. high, and weighing $15\frac{1}{2}$ lb. A female trapped by Mr. Finlay McGregor, Ardachie, was 38 in. long. The largest wild cat in the Scottish collection was sent to South Kensington last year, being a tom killed on Fearn grouse moor, Ross-shire, reaching $39\frac{1}{2}$ in. in length and weighing 15 lb. 10 oz.

The status of the fox depends upon fox-hunting, for which it is protected, and if it were not for fox-hunting the fox would have followed its relative the wolf to extinction in our countryside a hundred years ago. Badgers and otters, however, are less dependent upon man's protection, for they are probably no less numerous in Britain to-day than thirty years ago, and occur with such persistent regularity on the borders of London, Liverpool, Birmingham, and Manchester that one doubts whether they are at all in danger of reduction: they seem to defy persecution. In 1918 an otter was found on the railway at Acton, while in May, 1934, a badger was electrocuted on the railway at Elmstead Woods, 11

miles from London Bridge. I have known badgers and otters electrocuted on the railways near Liverpool and it is certain that any increase in electric railways with live rails will be a danger to mammals crossing them.

The Status of the Seal.

A hundred years ago the grey seal was considered to be very rare in Britain, but examination of old records shows there was much confusion, and the grey seal, which is by far the commonest seal of our rocky west coast, in fact probably the only seal, is probably now more numerous on the whole than the common seal of the east coast. On Anglesey, Grassholm, Skokholm and other parts of the Welsh coast, and Orkney and Shetland in Scotland, the grey seal colonies are flourishing, and, as with the badgers inland, sane propaganda is converting the former destroyers of seals to an appreciation of their usefulness in the balance of nature. As I pointed out in *Nature* in 1933, the grey seal feeds largely on cod, dogfish, and cuttlefish on our coasts, and these fish are destructive to commercial fisheries. While many laws have been framed in recent years to ensure the future of British birds, little legal protection has been given to the mammals, but the 1932 Act protecting the grey seal from September 1 to December 31 (its breeding season) should be a great help to this species.*

All our voles, including the Orkney and Skomer voles, seem as numerous as they have ever been. Our knowledge of the British voles, as of the shrews and squirrels, has been greatly increased by the researches of the Oxford University Bureau of Animal Population, under the direction of Mr. A. D. Middleton. With the voles, there seems a definite cycle of increase and decrease, with peak years about every four years, 1914, 1918, 1922, 1926 and 1930 being years of abundance. It is not yet certain what causes the periodic decrease in the voles, for there are no mass migrations in this country commensurate with the well-known movements of the lemmings in Scandinavia. Hawks, owls, stoats, weasels and foxes—perhaps badgers too—prey on them, but, as their numbers are more or less constant in the countryside, they cannot be the cause of the cycles. Hard frost and snow may reduce the voles, as the severe 1928-9 winter, but there are contradictions to this theory, and with other rodents, like rats, a very wet year often sees their increase.

Of the other rodents, the squirrels cause interesting speculation. The advance of the alien grey squirrel since the early liberations in Cheshire (1876), Middlesex (1889), Bedford (1890) and Loch Long, Scotland (1892), which by 1930 had covered the South, the Midlands, the Home Counties, much of East Cheshire, North



The harvest mouse is another dwindling species.

[Photograph by Douglas English]

*See, however, the note in *Discovery*, Jan. 1935, p. 2.

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Yorkshire, and parts of Central Scotland and Central Ireland, later received a serious set-back, and by 1934 the "menace" of their overrunning the countryside by 1950 seemed gone. It has recently become known that grey squirrels are on the increase again at a quicker rate than before, having completely recovered from the epidemics of 1930-4, and are rapidly spreading from their old haunts in spite of the publicity given to their misdeeds. In the north, where few grey squirrels penetrated outside Yorkshire, the red squirrels held their own against the few newcomers, but our native red squirrels have been much reduced in the past thirty years, irrespective of the grey invaders. In Lancashire, for instance, where, except for three isolated records, no grey squirrels have occurred, the red squirrels are very much scarcer than at the end of last century, a few existing near Liverpool, a pair at Knowsley, some at Blackburn, and others in the northern hill-woods. In North Leicestershire red and grey squirrels have been noticed inhabiting the same wood without coming into conflict, while in Northamptonshire the red squirrels had decreased before the few greys arrived. In the last few years, however, a slight increase in red squirrels has been noted in some north-western haunts and they may be increasing again. It is doubtful, however, if the red squirrel will ever be as common again, thanks to the vast reduction of woodlands.

Declining Rodents

The dormouse and harvest-mouse are declining rodents, and the next twenty years may see the extinction of the harvest-mouse. I have not traced an authentic northern record of the harvest-mouse during the present century, most countrymen's reports being of ordinary field-mice; but there are specimens still breeding annually in parts of East Anglia, Herefordshire and the South, a Hampshire correspondent of mine having captured two when ratting at a straw stack near Andover just before Christmas, 1933. There are still dormice in Wales and the South, but they seem to have been exterminated in the North and very scarce in the Midlands, where we have met only two in recent years in our own observations, one in Northamptonshire in 1932 and another in Leicestershire during the war.

The status of the meadow-hare again depends largely upon sport, and, owing to the frequent introduction of mountain-hares for hunting or shooting, as in S.W. Yorkshire, Cheshire, and North Wales, it is difficult to decide whether such fauna should be included in scientific records. In Scotland, however, there has been a definite increase in mountain-hares in recent years and they have spread to new areas; if this increase continues



The noctule, our largest British bat, flourishes in a suburban environment.

[Photograph by Ray Palmer]

it may have interesting effects on grouse, on golden eagles which feed largely on mountain-hares, and on vegetation.

The future of the rat, despite the annual Rat Week, the first week in November, gives cause for much speculation in view of Mr. A. C. Hinton's evidence of an increase of the black or ship-rat in the London area in recent years. A corresponding increase has been noted at Scarborough, but at Liverpool, the greatest port and rat centre in Britain, there has been no such increase. The increase of the black rat, however, cannot be taken as a sign of plague danger, for our port sanitary officials have improved their technical and trapping skill and they have the rats well under control. At Liverpool, compulsory fumigation of all vessels is now carried out and thus, while the average number of rats per ship in 1923 was 58.83, in 1933 it had been reduced to 2.05 while that of mice had been reduced from 0.63 to 0.58. Comparing the annual statistics from the public health department, relating to the places of origin of trapped rats, which are graded into black and brown species, the proportion of brown to black in the warehouses is a little more than 3 to 1; in the sewers the brown rats predominate, in the ships the black, while on the dock-quays the black outnumber the brown in a proportion of a little more than nine to one. Though common black rats have been found ten to fifteen miles inland from docks, the Alexandrine and Tree rats seem confined to the ports. The menace of the alien muskrat, like that of the grey squirrel, has now ceased and in Shropshire and elsewhere the trappers have them under control, and are reducing them. The depopulation of St. Kilda is said to have endangered the interesting St. Kildan Mouse, but time alone will

show whether this island race is dependent upon man for its existence.

Lastly, regarding the future of our deer, this largely depends on hunting and financial fortunes. Wild red deer have increased in recent years in Scotland and Lakeland, so much so in the Martindale forest of Lakeland as to wander down to North Lancashire and there to live wild in increasing numbers ranging from Furness through Westmorland to parts of the West Riding. Roe deer still hold their own in the North and are quite common on the Lancashire side of Windermere. The wild red deer and roe deer of the South are largely protected by the hunting interests. There are roe deer in Somerset, Dorset, Wiltshire, Hampshire, Sussex, and Surrey. Sixteen roe deer have been shot in

recent years in a small Hampshire covert shoot, while specimens have been seen as near London as Hartford Bridge Flats, by Camberley, but as the roe moves about only at dawn and dusk, it is little known. The private herds of English parks, mostly red and fallow deer, are decreasing, in view of the increased taxation and the breaking-up of big estates. There are about 7,500 deer in the parks of Britain, the King being the largest owner, with 819 at Windsor and 150 at Sandringham. Two years ago the Deer Herd Book Society showed 46 registered herds of deer in the country, the fallow deer at Ashton Court, Somerset, having been preserved since 1392, while the red deer at Melton Constable Park, Norfolk, date from the 13th century; most of the herds, in fact, were established in the 13th and 14th centuries.

Detecting Milk Frauds.

By C. R. A. Martin.

The Hortvet Cryoscope is an ingenious contrivance which, by taking advantage of the natural properties of milk, enables analysts to distinguish between honest poor-quality milk and adulterated milk. The author, who has had much experience of practical food-inspection, explains the process, which is more generally known than it is understood.

ONE of the oldest forms of adulteration is the addition of water to milk. For the greater part of a century there has been legislation and inspectorial supervision to check the practice and, with the heavy penalties which have been inflicted for offences, it has now undoubtedly been reduced to a minimum. It is still the principal form of food adulteration, however, for, as milk retailers dispose of their entire stock each day, making adequate supervision difficult, there will always be those who are prepared to take a chance and probably get away with it, since each day wipes out the evil thereof.

For analytical purposes, milk is divided into three parts: fat or cream; non-fatty solids, consisting of lactose or milk sugar, protein, and mineral matter (sometimes called ash, salts, etc.); and water. To assist analysts and magistrates in dealing with cases of alleged adulteration, a legal standard was adopted many years ago. It prescribes that "genuine" milk shall contain not less than 3 per cent. of fat and 8.5 per cent. of non-fatty solids, and any sample falling short of these figures shall be *presumed* to be not genuine by reason of the abstraction of cream or the addition of water.

The abstraction of cream is not difficult for an analyst to detect, but an excess of water, *i.e.*, above 88.5 per cent., is a different matter. Until comparatively recently, analysts could never state definitely whether water had been added to a sample or whether it was a genuinely poor milk, exactly as the cows gave

it. Whilst most cows yield milk above the prescribed standard, it has long been known that some cows at different times of the year and a few continuously give milk below it, and in consequence the legal position is that if it can be proved to the satisfaction of the Court that the milk has not been tampered with, no offence has been committed. This has been the state of the law for the last twenty years or more and, although every sympathy can be extended to farmers in genuine difficulties, it has undoubtedly opened the door to fraudulent practice.

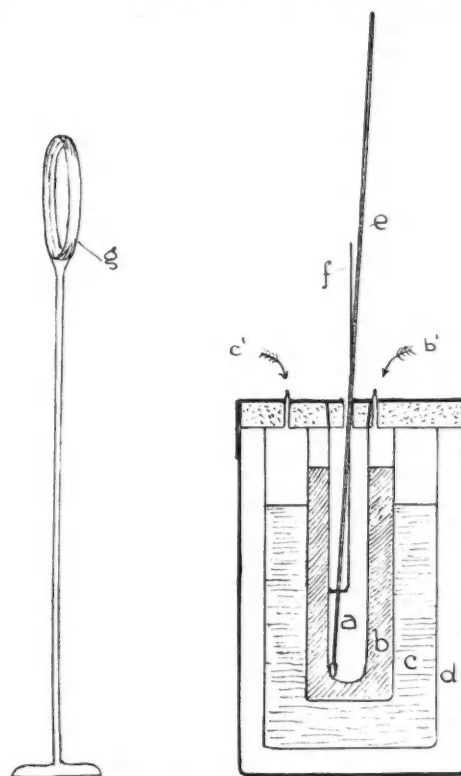
In the Hortvet Cryoscope analysts have an apparatus which, if not absolutely infallible, enables them to state with a reasonable degree of accuracy whether water has been added or not. Designed by Julius Hortvet, a Minnesota dairy chemist, it depends for results upon two well-defined characteristics of milk, *viz.*: (i) the fact that all genuine milk whether below standard or not freezes between minus 0.53° C. and minus 0.57° C.; and (ii) certain fixed ratios between the various constituents of the non-fatty solids, usually called Veith's ratios (after Dr. Veith, a dairy chemist working at Aylesbury, Bucks, who established the fact in the course of analysing many thousands of samples of milk).

The apparatus is simple in design and operation. It consists of a vacuum flask containing, as well as the vacuum, compartments for ether and alcohol. Into the alcohol bath, as shown in the accompanying diagram,

a tube containing milk is inserted. The ether acting on the alcohol reduces its temperature to below 0°C .; this in turn cools the milk, the temperature of which is recorded by a special thermometer graduated to hundredths of a degree, a magnifying glass being provided to ascertain correctly the reading of the thermometer. The freezing test takes only a few minutes. The milk is kept constantly agitated by stirring while it cools and, when the thermometer records -1.3°C ., a crystal of ice is dropped in, bringing the mercury back to the actual freezing point, where it settles, indicating that the milk has frozen. If the milk is genuine, the thermometer reads -0.55° , or at the most -0.57° . If above this point, *i.e.*, nearer to the freezing point of water (0°C .), it is proved that water has been added to the milk.

A long and complicated theory supports the freezing test for milk adulteration. It may be thus briefly explained. If a bladder full of vinegar, for example, is securely tied to make it airtight and then immersed in a pail of water, it will be found after a few days that the contents of both pail and bladder are an even mixture of vinegar and water. The explanation is that the fluids have passed through the minute pores of the ostensibly watertight bladder by osmosis and at rates dependent upon the osmotic pressure of the different fluids. By the same process, blood passes through the fine capillary walls of the mammary glands to form milk and, since milk is formed from blood, it follows that its osmotic pressure must be about the same and also as constant as that of blood. It is difficult to measure osmotic pressure, but it is known that there is a definite relation between the osmotic pressure of a fluid and its freezing temperature. The osmotic pressure of milk is dependent upon its soluble contents, *i.e.*, the non-fatty solids; the cream content being in suspension does not affect it. Similarly, a solution of salt in water, by increasing its osmotic pressure, lowers its freezing point below 0°C . and conversely the addition of water to milk by reducing the concentration of soluble matter, and therefore the osmotic pressure, raises the freezing point nearer to 0°C . Such is the explanation of the practically constant freezing temperature of milk, but it still does not explain how, of two samples of milk, both below standard, an analyst is able to say of one, "this has extraneous water," and of the other, "this is a genuinely poor sample, exactly as the cow gave it." To do this, one must refer to Veith's ratios. Veith found that in all except physiologically abnormal samples, if the non-fatty solids are divided into 24 equal parts, then 13 are of lactose or milk sugar, 9 of protein, and 2 of mineral matter, and that the addition of water did not alter these ratios of 13:9:2 in the slightest. Now in those

genuinely poor milks, which although below the legal standard still register the correct freezing temperature, these ratios are out. The lactose is down and, to a lesser extent, the protein also, due to an abnormal deficiency of these substances in the blood of the cow, but to maintain the balance of osmotic pressure both in the blood and milk, there is a corresponding increase



THE HORTVET CRYOSCOPE.

a : milk. *b* : ether. *b*¹ : inlet for ether. *c* : alcohol. *c*¹ : inlet for alcohol. *d* : vacuum. *e* : thermometer. *f* : stirrer. *g* : magnifying glass.

in mineral matter, salt. As the osmotic pressure of salt is ten times greater than that of lactose, the increase does not quantitatively correct the deficiency. Consequently the non-fatty solids, as a whole, remain below the standard of 8.5 per cent.

There is only one precaution necessary with the freezing test, but a very important one. The milk must be quite fresh. Incipient souring reduces the lactose, which in turn reduces the osmotic pressure and, of course, in this case there is no counterbalancing increase of salt. The Hortvet Cryoscope has thus made it possible to detect frauds in milk and at the same time to prevent a stigma being inflicted on farmers who are blameless as far as watering milk is concerned.

New Light on Irish Antiquity.

By E. N. Fallaize.

ANTIQUARIAN studies in Ireland have suffered more from excess of zeal than from neglect; and efforts to illumine the romantic twilight of the Celtic world by the searchlight of an exact archaeological knowledge, which frequently fails to corroborate popular conceptions, have not always received cordial greeting. Professor Macalister in his "Ancient Ireland"* makes no concession to sentimentality. To him the truth and nothing but the truth is the only romance.

His faith is justified in the facts, not only as they are set forth in his reconstruction of the cultural history of Ireland, but even more in the preliminary results of the extended scheme of archaeological investigation subsidised by the Free State, of which some account was given in the April issue of *Discovery* (p. 99). Although these results were not available for Professor Macalister for more than brief and incidental reference, his main conclusions stand unaffected.

Ireland possesses in the cycle of heroic legend, of which Cuchulainn is the central figure, a picture of a tribal society which is more "primitive" than any in European tradition, with the exception of parts of the *Mabinogion*, to which, indeed, it is closely akin, in this respect, and the Finnish *Kalevala*. Professor Macalister himself has shown in an earlier publication the essentially primitive character of the Tara tradition; and to this he now adds, from the heroic legends of the Ulster and Connacht heroes, examples of customs and beliefs which find their natural analogy in the matriarchy, the totemic and tabu practices, and the secret societies of the Australian aborigines and the natives of the Pacific.

The society which

Professor Macalister thus evokes from heroic legend differs *toto cælo* from the Ireland of romance and of the imagination which has played on the incontrovertibly high artistic achievement of the Irish bronze age. But, as he argues, examples can be adduced to show that high artistic achievement does not necessarily connote a high general level of culture. The conclusion is inevitable, not only on *a priori* grounds, but also on concrete archaeological evidence, that Ireland, owing largely to her geographical position as an outlier of Europe on the periphery of cultural and ethnic migration, had a considerable lag in culture, just as she undoubtedly had in the biological field.

The value of tradition is problematical, and must vary according to circumstances. Irish legend sets out a remarkable succession of invaders—Partholon, Nemed, Fomorians, Fir Bolg, Tuatha de Danann, and Milesians—which has been regarded by archaeologists with a very variable degree of respect, this notwithstanding the coincidence by which the legends derive the peoples and culture of Ireland from those very areas, Spain, the eastern Mediterranean, and countries even further east, to which archaeological reasoning has led as the starting points of racial and cultural influences which have converged on Ireland. It is here suggested

by the author how far it is possible for inconsistencies to be smoothed away, and to what extent the traditional succession may be substantiated by the interpretation of archaeological evidence.

The ethnic and cultural dichotomy of Ireland, which persists in the modern political separatism of the northern state, though this may be attributed to the Cromwellian plantations, appears, as Professor Macalister points out, at the earliest stage in Ireland's cultural history. Now that Ireland is to be deprived once more of her palæolithic age—a view in which apparently our author concurs—the earliest cul-



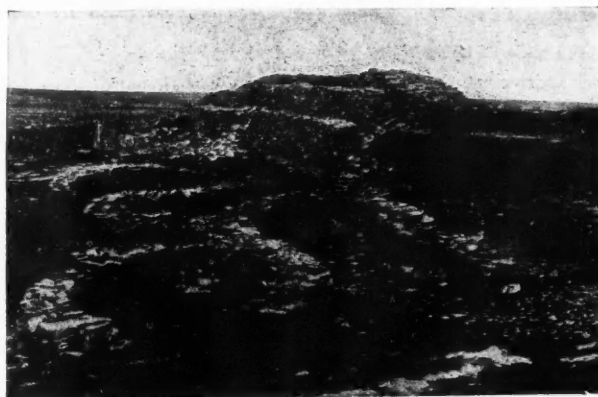
The grave-slab of Feidlimid, who was "slain for no just reason," as the Latin inscription tells. The design is typical of the late ninth century.

* *Ancient Ireland*. By R. A. STEWART MACALISTER. (Methuen. 10s. 6d.)

ture is mesolithic, appearing in north-east Ireland. In part it is Asturian, affiliated to the culture of western Spain, in part Campignian in character, tracing its relationship through Britain (Windmill Hill) to roots in the Baltic. The distinction between the north and the rest of Ireland, however, is more clearly to be seen in the distribution of the later horned cairn which belongs to

the north. This distinction in culture and character which is very marked throughout pre-history and history may very well be racial, as its geographical position and character might suggest; but Professor Macalister attributes it to the bracing climate of the north-east. He is, indeed, strongly of the opinion that the difficulties and tribulations of Ireland throughout her history are to be attributed to her climate and the mental, social, and economic consequences due directly to its enervating and unduly moist character. It is not a little significant that that glory of prehistoric Ireland, the earlier culture of the bronze age, coinciding, it is true, with an enormous wealth in gold, also coincides with a climatic optimum, while the break in the latter half of the bronze age, which Professor Macalister now admits, coincides, as readers of the article to which we have referred will remember, with a marked break and deterioration in climatic conditions.

We must forgo any attempt to follow our author in detail in his analysis of the succession of races and cultures of Ireland and their derivations—Men of the Halberd and Men of the Sword in the bronze age, the Men of Iron, Men of the Cross, and Men of the Bays (from Scandinavia)—down to historic times. His pages are packed with brilliant suggestion and close and careful observation, nor do they shy from a sardonic glance here and there at present discontents in the light of the teaching of archaeological research. In the examination of the many problems which come up for consideration, the proposed identification of the great prehistoric forts of Aran as the last strongholds of the Men of the Halberd against the Men of the Sword, the suggested solution of the riddle of that remarkable and stupendous monument, New Grange, and the tenta-



A fort on the island of Aranmore, one of the last refuges of the "Men of the Halberd."

tive derivation of the ogham writing from manual signs, each in its degree once more assures the reader of Professor Macalister's quality as an archaeologist.

For certain problems in the present state of our knowledge Professor Macalister can offer no solution. He discusses the Celtic question in its reference to Ireland acutely; but here he himself would be the last to lay any claim

to finality. So too he is at a loss before the hiatus which precedes the great revival of Celtic art in the form and ornament of the cross and the illuminated manuscripts of the eighth and succeeding centuries of our era. Possibly here too, as he has turned to Britain in an earlier period, he may seek in the "Celtic" art of Britain a possible source, as Mr. T. Kendrick would suggest.

The time was ripe for an attempt to reconstruct the cultural history of early Ireland in the light of all the evidence of various kinds and from various sources which has accumulated in the last thirty years. Professor Macalister has made a bold attempt at synthesis, for which gratitude will be proportionate to the inevitable discussion it will arouse.

(Continued from p. 174)

position. It may be that still other alternatives remain to be discovered, and another few years may witness some new formulation of the problem which will lead to a satisfactory solution." So the "finite space" and "finite universe" appear to have escaped the control of "the astronomers" after all, and to have insisted on asserting their infinitude.

Both a finite and an infinite space are inconceivable to the human mind. But the latter is far the more natural supposition. Let us remember what the Angel said to the man in De Quincey's magnificent prose-poem: "End is there none to the universe of God? Lo! also there is no beginning."

Yours faithfully,

GEORGE EASTGATE.

Stanley Road, Woodford, E.18.

May, 1935.

[As we go to press it is announced that Professor Einstein has made a further statement, which leaves the issue still more in doubt.—ED.]

Correspondence.

SECURING A WATER SUPPLY.

To the Editor of DISCOVERY.

Sir,

The simplest device for securing abundance of water in this country is to get our agricultural land back under the plough instead of "waterproofing" it with inferior and matted pasture. In spite of a wet December the soil under a meadow which I broke up last winter was very dusty and dry. As a landowner of some 30 years experience, I have observed that the springs on the lower portion of my land in their abundance or paucity reflect the state of the cultivation on the higher portion of my farms. Of course, this is quite obvious to any but a town-bred politician. The securing of a good supply of water to many of our villages and the prevention of floods would be among some of the numerous benefits which would accrue to this nation from a revival of agriculture.

Yours faithfully,

R. S. DYOTT.

The Manor of Freeford,
Lichfield, Staffs.

May, 1935.

RE "HIGH-SPEED FORESTRY."

To the Editor of DISCOVERY.

Sir,

Some serious errors occur in the article "High-Speed Forestry" published in your issue of last March.

In particular, on page 83 it is stated that "The Institute of Science and Industry (the Australian Government Scientific Research Department) devoted their attention to it . . . Under actual test, this department, with its own acres of trees, proved the phenomenal fact . . ."

Neither the Institute of Science and Industry nor the Council for Scientific and Industrial Research (which replaced the Institute in the year 1926) has at any time investigated the growing of pine trees nor have they possessed their own acres of trees.

It is true that both the Institute and the Council have given much attention to the utilisation of Australian-grown timbers and have studied the utilisation of *Pinus radiata* to some extent; in passing it may be mentioned that as a result of such investigations the Council is impressed with the considerable difficulties to be overcome before the rather numerous organisations growing *P. radiata* in Australia and New Zealand can successfully market their product.

Another inaccuracy is the statement, also on page 83, that Professor Chapman's findings "were published by the Australian Federal Government (Woods and Forests Department, Bulletin No. 1, 1928) . . ." The Woods and Forests Department referred to is a State (South Australian) and not a Federal Department.

In conclusion, we would be glad if you would please publish this letter as the Council for Scientific and Industrial Research certainly does not wish to be associated in the minds of your readers with the statements regarding pine-growing made in the article we are discussing

Yours, etc.,

G. LIGHTFOOT, Secretary.

Council for Scientific and Industrial Research,
East Melbourne.

April, 1935.

TREES IN CHURCH WALLS.

To the Editor of DISCOVERY.

Sir,

A somewhat similar case to the one described by your correspondent in the April issue of DISCOVERY may be seen at East Newlyn, Cornwall. In this case a large fig tree issues from the south wall of the church. I cannot send a photograph at present, but this is no loss as the only available view-point gave a picture that made two props appear to be trunks rooted in the soil.

After close examination both inside and outside the church, I came to the conclusion that the exceedingly thick wall was probably only faced with stone on each side, the interior of the wall being filled with any material available, possibly that mixture of soil and small stones which is known as "pug" in some parts of Essex. Any seed which once contrived to get a rootlet through the stone facing into this could live and thrive quite happily, especially a fig, which prefers periods of partial drought.

Yours faithfully,

H. SANDERSON STEWART.

Stokefield Nursing Home,
Malvern.

P.S.—I have read every number of DISCOVERY for the last five years, and the present number has done much to help me through a rather bad day.

THAT "FINITE" UNIVERSE.

To the Editor of DISCOVERY.

Sir,

Dr. A. S. Russell's article in the May number of DISCOVERY is pleasant reading, and there is one passage which particularly interests me in view of two recent developments. The passage is as follows:—

"A consequence of Einstein's theory is that our universe of space-time is finite and closed; there is only a finite amount of matter in the universe—literally everything, literally everywhere. And from this *supposition* experiment and theory have led astronomers to believe that this universe is expanding with time."

I like that word "*supposition*," which I have taken the liberty of italicising. It is apparently the word that ought to have been applied all along to this speculation about a "finite and expanding universe," a "finite and expanding space," and even a "space that curves back on itself," so that "if you travel long enough on a *perfectly* straight line you will come back to the spot you started from." The two developments mentioned above are as follows:—

In *The Times* of 29 December, 1934, a message from New York said that "In an interview at Pittsburgh to-day (28 Dec.) Professor Albert Einstein said the universe might be infinite after all. There was a very good chance that it was." This was sufficiently startling to those who have been watching with intense curiosity the vagaries of this "finite universe" supposition. But there was more to follow. In *Nature* of 4 May (Royal Jubilee Number) there is an article by Sir James Jeans, hitherto a great advocate for the "finite, expanding, and curved space" supposition, ending as follows:—

"Einstein now appears to contemplate the possibility of a zero cosmical constant and a space of infinite extent. But it is, I think, fair to say that no one is satisfied with the present

(Continued on p. 173.)

What are Scientists ?

By Gordon A. Jahans, M.A.

The author's conclusion that the pursuit of Science requires no specialised ability, but rather a reasonably good level of general intelligence, is obviously of great importance to DISCOVERY and its readers. The processes leading to this conclusion and the illustrative methods employed are of high interest, both to psychologists and to the general reader.

EVER since Descartes wrote his "Discourses" a growing band of men and women in Western Europe has been questioning Nature in a particularly methodical manner. The knowledge these people have acquired by their questionings has been so systematised and extensive, and now seems to outrun common-sense so far that some are inclining to the view that scientists are a specialised type of human being. How far are we justified in this view of them? If they are really a peculiar people then what manner of men are they?

These questions are not new. They have been asked in an indefinite sort of way many times; and they have been asked definitely in America, where it seems that psychology is put to more practical use (and misuse) than anywhere else in the world.

The American investigator of these questions seems to have made some quite unwarranted assumptions and, therefore, although the investigation was carried out as lately as 1918, his results are already considered of little value. Indeed, when the investigation was made, the particular statistical machinery and psychological theory for obtaining a definite reply was not available, for Professor Spearman of London University had not then fully expounded his theory of "g" and the consequent theories of specialised abilities. Without egotism, therefore, I may say I am the first to have attempted to answer the questions in the light of Spearman's theory and, with the aid of the specialised mathematical and statistical machinery suggested by him, I propose here to give only one small facet of the conclusions at which I have arrived, but which, I hope, will be of interest to the readers of *Discovery*.

Spearman's "G" Theory.

For a detailed exposition of the "g" theory the reader is advised to seek Professor Spearman's own very lucid and learned description in his work, "The Abilities of Man." For our purpose here I must content myself with the very briefest but, I hope, not inaccurate statement of it. According to Spearman, the intellect of a human being may be imagined to be made up of a very large number of abilities, the number of these, of course, varying from individual to individual. All these abilities are linked together by means of what he has preferred to call "g," but which for our purpose

may be taken as "general intelligence"; "g," a purely imaginary quality of the mind, serves very much the same purpose as the ether served for the physicist. It cannot be said to exist by itself and, indeed, cannot be isolated or examined at all except through the medium of the abilities. It varies from individual to individual and can definitely be proved to grow very rapidly in the individual from birth till, say, the age of fifteen and then almost to cease growing altogether.

The abilities displayed by individuals may be innate or acquired, and are aided and linked together by this "g." An individual with a large amount of "g" will always be able to produce better results from his abilities and talents than the individual who is only meagrely endowed with it. Thus "g" may be likened to a large steam boiler supplying a number of small engines which represent the abilities whose performance depends upon the efficiency of the boiler. The simile may be carried further. Some of the engines may be visualised as being linked together by means of a single steam chest. These linked engines are the special abilities, and when the influence of the boiler has been eliminated one can still trace the influence of the steam chest. The single abilities show no linking when the influence of "g" has been eliminated.

Specialised Abilities.

In the case of arithmetical ability and mechanical ability and one or two others a definite specialisation or linkage between the parts has been discovered. They are, therefore, termed specialised abilities. It is this theory and the mathematical machinery by which it is expounded that have supplied the modern investigator with a sure means for the discovery of specialised abilities if such are suspected to exist.

To return to our questions, we may now ask, is there such a specialised ability among human beings as scientific ability? Does the ordinary man in the street possess it or is it only confined to professors of science in our universities?

My first task in endeavouring to answer these questions was to discover exactly what constituted scientific ability. To do this I had to recall and isolate as far as possible as many mental acts which a scientist might be thought to perform in carrying out some scientific

inquiry. The more I thought and inquired the longer became my list until I became convinced that I was proposing to make a list of all the thought processes involved in living in a dynamic and colourful world. The problem was too large to attack in this way in a single lifetime. I was forced to make a selection of a few representative and obvious processes and then by examining as large a population as possible to discover whether any or all of the processes showed any linkage other than that afforded by the common factor "g." Or, speaking statistically, whether there was any correlation between the processes after the influence of "g" had been "partialled out" or eliminated. If any such super-correlation were found then, obviously, it would be due to some common factor which linked the processes together and, since it could not be general intelligence, then it might be termed scientific ability or at least a specialised ability which came into play when these particular scientific processes were employed.

The processes which were to be examined having been selected, the next task was to avoid as far as possible a

of tests was invented and compiled, in which the examinee had only to deal with things rather than words and abstractions designated by numbers. The "things" too were made as artificial as possible so that they should be quite new to the examinee, and they were also made colourful. The whole series of tests consisted of coloured patches painted on sheets of paper, and with these the examinees were set problems to solve without the aid of either figures or letters. In short, the examinees were asked to solve simple problems presented in form and colour.

But it may be argued that the scientist uses all his senses—touch, hearing, taste, smell, and sight and, some say, a sixth of which the psychologist is not aware. My problems entered the subject's brain only by the gateway of sight. Again I was presented with a multitude of avenues of inquiry and I had to make a choice. Moreover, if the sense through which the problem enters the brain produces a specialised ability, then surely it is not a psychological but a physiological one. So I chose sight.

I content myself here with a brief description of two as typical. Classification appeared as a simple process which all scientists are called upon to perform. I, therefore, built up two tests typifying two methods of classification in everyday use. Surely if there were a specialised ability it would appear here, for upon a superficial examination all classification seems to call forth the same or kindred abilities. But the result of the examination has proved that there is no super-correlation between the two methods of classification. That is, while a doctor classifying a disease by diagnosis and a botanist classifying a plant seem at first to be employing at least kindred mental processes, actually the amount of correlation between the two processes after elimination of "g" amount to the insignificant fraction of .09. The two tests employed for the purpose are illustrated by the accompanying photographs.

The problem was briefly explained and illustrated by means of the chart shown in photograph A. After the explanation, chart B was shown, and the examinee was asked to look and indicate by their numbers all the shapes on the right of the black line which resembled the patches on the left-hand column (lettered) in any one way, either by means of a common colour, shape or mark. That is, the subject was asked to classify all the numbered shapes under as many as possible of the six lettered groups: a very simple and straightforward problem. If the subject was colour blind he might miss some of the groups, but he still had enough remaining to give an indication of his ability to perform the task in hand.

I regret that the charts here represented by photo-

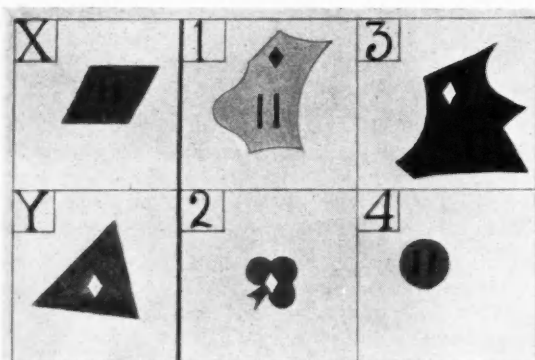


Chart A, an explanatory chart illustrating the problem to be presented by Chart B.

spurious correlation between the abilities tested, caused by the existence of the known specialised abilities. A specialised ability in arithmetic is definitely known to exist. This had to be rigidly avoided in testing the processes. Literary ability may also exist—but this is by no means certain. At any rate there was no need to take any unnecessary risk; hence all "figuring" and "lettering" was eliminated as far as possible from the tests that were applied. Again, too great an incrustation of knowledge was to be avoided since this might behave in all sorts of unknown ways in the minds of the examinees. Hence children between the ages of eleven and fourteen were tested. With these and some other more technical safeguards in mind a series

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graphs cannot be reproduced in colour. By using only one colour we place ourselves in very much the same position as the totally colour-blind examinee and must be content with only one part of the whole problem.

The second test I have given here is the one I have designated as diagnosis. In work-a-day terms it amounts to this: the doctor calls, sits by your bedside, and notes that your eyes and nose are causing you annoyance by secreting an abnormal amount of moisture. He examines your chest and perhaps finds some spots on your skin—he takes your temperature and finds it above normal. He may even examine your throat. Suppose after looking for all the marks which he has learned to look for he only finds two. If no spots are present he may diagnose influenza. On the other hand the presence of spots may cause him to classify the attack as measles. Upon the acuteness of his observation will depend under what class he will place your complaint and the consequent treatment he will give you.

Chart C places every examinee in the position of the doctor. The problem is greatly simplified, but in essence it is diagnosis. Again an explanatory chart was shown and the problem explained. When the larger chart C

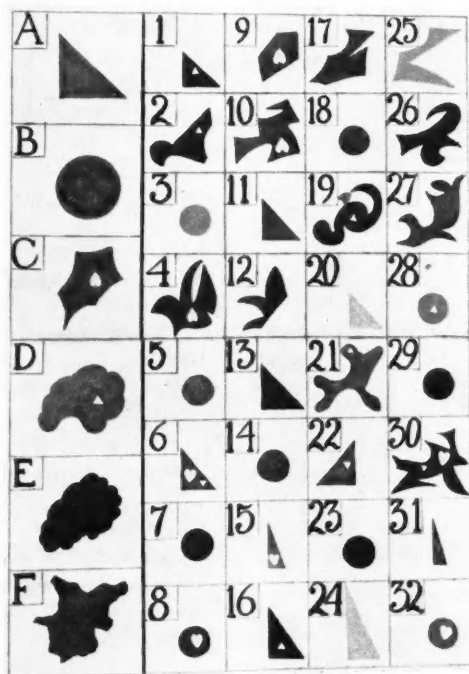


Chart B, used to test the ability to classify. The problem consists in arranging the numbered patches in accordance with the six guides in the left-hand column.

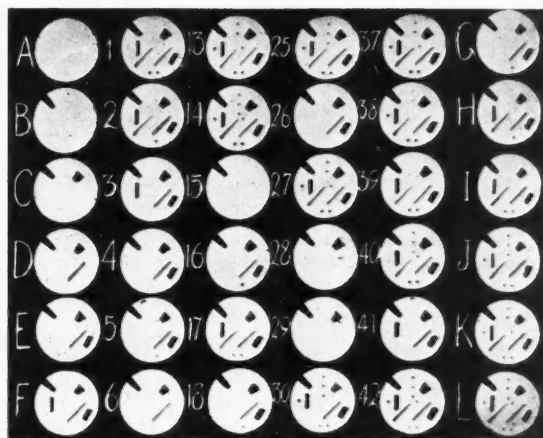


Chart C, used to test the ability to diagnose. The problem is to classify the numbered circles into the groups indicated by the lettered guides on the right and left. Only a part of the original large chart is shown here.

was shown the examinee was required to group the numbered circles in the four central rows into the twelve lettered groups in the outer rows, so that all the circles in the group should have marks upon them which would be identical in shape, colour and position.

Here, then, are two processes which any one would have said were certain to be performed by the same department of the mind. But, as I have said, this is not the case. There is no relationship between them. And so through the other process which I have examined and of which I hope to publish a fuller account elsewhere, there is no relationship between them other than the relationship produced by the fact that they are energised by the same boiler, "g."

What is the practical outcome of this? It is surely this, that no child should be denied the right to receive a scientific education since every child is capable (within the limits of his general intelligence) of performing the mental processes involved in scientific thinking. A very heartening result indeed.

Empire Radium.

Twenty tons of pitchblende ore, valued at £40,000, have already been brought by air to the Port Hope refinery from the newly-discovered radium deposit at Great Bear Lake, Canada. This is barely one-tenth of the total that is to be transported from the area this summer. Canada's radium industry is now firmly established, thanks to the shipment by air last year of some 750 tons of equipment, and what was practically a world monopoly has been broken.

The Ethics of Headhunting.

By J. P. Mills, I.C.S.

Hon. Director of Ethnography to the Government of Assam.

That customs change with latitude is a truism. Patriotism assumes many strange forms, but it is surely strangest of all that the acquisition of an enemy's head should be regarded as an act of social virtue. Our author throws an interesting light on this aspect of savage ethics.

WHY should a devoted husband, a kind father, and a loyal friend be eager to decapitate any man, woman, or child who does not belong to his village? A man will readily marry a woman from another village and yet will not hesitate to ambush her near relations, and I have even known a man take the head of his own brother who happened to have migrated elsewhere, though this act met with general disapproval.

The days are over when ethnologists were content to describe strange customs, the stranger the better. Description is still an essential part of their work, but interpretation is even more important. It is now realised that in a primitive culture, built up by the experience of ages, all beliefs and all activities fit together like the parts of a machine. Nothing is superfluous, and no custom or ceremony can be suddenly eliminated without affecting the whole. The fact that headhunting is not merely the sport of irresponsible criminals but the pursuit of persons of otherwise estimable character, even by our standards, shows that it plays an important part in the lives of those who practice it. Ethnologists have been tackling the problem of what that part is.

Headhunters exist, or have existed, in many parts of the world. The aborigines of Formosa, the Dyaks of Borneo, the Wa of Burma, the Nagas and Kukis of Assam, some of the Amazon tribes, and many others occur to the mind at once. All headhunting communities naturally value a human head as a trophy which proclaims the prowess of the slayer. But apart from this two forms of belief can, broadly speaking, be distinguished. Some tribes, typical of whom are the Kukis of Assam, esteem a head chiefly because it provides the taker, or the man in whose honour it was taken, with a slave in the next world. Other tribes, of whom the Wa of Burma are an example,

seek heads because they confer an immediate benefit both on the takers and the whole community. Sometimes the two beliefs are held concurrently, as by the Ao Nagas of Assam.

In the limited space at my disposal I do not wish to discuss the first form of belief. It is by an obvious process of thought that a man can be held to capture the soul of his victim and keep it in bondage in the hereafter. The second form of belief merits further consideration. One notices certain points at once. Firstly the victim must be a stranger. To kill a member of one's own village and so weaken it is the worst crime a savage can commit. Usually no distinction is drawn between deliberate murder and pure accident, and I have known a Naga suffer the supreme penalty of exile and destruction of all property because a stone casually thrown by him glanced off a rock and killed a child. Yet to kill a stranger, however treacherously, is a meritorious act. Any stranger will do, and Nagas whose raids had long been unsuccessful used occasionally in desperation to buy a slave and kill him in cold blood.

Secondly, the ghost of a dead enemy is likely to be malignant and steps have to be taken to prevent its following the killers. Sometimes this is done by cutting off the hands and feet of the corpse, or sometimes it is considered enough if the raiders on their return face the direction of the enemy village and sing the appropriate chant towards it. Many are the stories one hears of ghosts whimpering with impotent rage round the mutilated trunks.

But far more important than the ghost is the soul or personality. This resides in the head and can be carried home by the victor. On arrival it can be mollified by gifts of food and drink offered to the dead lips, and can be asked to call its relations to be killed. Sometimes,



Sema Nagas. Returned raiders singing towards an enemy village.

of course, precautions are taken to prevent its changing its mind and turning hostile. For example, when a skull was finally hung up after the ceremonies were over, the Ao Nagas used to hang a dog's skull with it, that its barking might drown any attempt on the part of the soul to shout a warning to its friends and relations. The Konyak Nagas say it is to deafen a head to questions from its own village that they fix horns over the ears, but more probably these horns are emblems of abundance. This brings us to the most important point of all, that heads are believed to benefit the crops and bring general prosperity to the village. Many customs prove this. For example, the Wa have a special headhunting season when the crops are being sown in the spring. Again the Eastern Rengma Nagas used to take heads at any time, but always stuck them on poles by the path leading to wherever their shifting cultivation might be that year. The ceremonies attendant on the bringing in of a head are designed to extract its virtue from it and make it available for all. Once they are over the head is of little account. Some tribes preserve old skulls as trophies, but in the villages of other tribes they soon drop from their rotting cane strings, and pigs' mouth and destroy them.

Of what nature is this mysterious virtue that a head is believed to possess? The line of argument seems to be as follows. Every village is a self-contained unit and a reservoir of "soul-force" in which all living things connected with the village share. This, with the soul, resides in the head of a man. Some have more "soul-force" than others, and it is the greater share which a prosperous man obviously possesses that makes his head a special prize. But all have some, even children, and if a stranger's head can be brought home the virtue attached to it can, as it were, be released and poured into the reservoir, so that men, cattle, and crops may flourish the more. The headhunter is not, therefore, from his point of view, a bloodthirsty savage. He naturally loves to win applause and the right to wear the ornaments of a warrior, but deep down there is a feeling that he is a patriot, ready to risk his life for the benefit of his fellows.

Mass-3 Hydrogen

The "Princeton Alumni Weekly" reports the success of Princeton chemists in producing the world's richest supply of tritium, the third isotope of hydrogen.

SEVENTY-FIVE tons of water "boiled down" until only ten drops were left: this seemingly pointless activity has occupied the attention of Princeton chemists for many months and they are not ashamed of it. The reason for their satisfaction is that they think the ten drops (one-half cubic centimetre) represent the largest and richest source of tritium, or heavy hydrogen of mass 3, in the world. Furthermore, they have demonstrated that mass-3 hydrogen can be produced by further electrolytic concentration of the garden variety of "heavy water" which is rich in deuterium, the hydrogen isotope of mass 2.

It was the discovery of deuterium (mass 2) which won for Professor Harold C. Urey of Columbia the Nobel Prize in 1934. Then it became known that a third hydrogen (mass 3) also exists, but is so rare that in ordinary water it is present only 1 part in 10,000,000,000. This third hydrogen has been produced artificially in the Cavendish Laboratories in Cambridge, England, and at Princeton by the nuclear disintegration process.

The term "boiling down" is not to be taken literally but as the popular paraphrase describing a chemical operation like that which takes place in a storage battery. Used "battery water" contains a concentration of deuterium and tritium much greater than ordinary water.

About a year ago, by the use of the mass spectrograph designed by Dr. Walker Bleakney, of Princeton, it was shown that the "heavy water" (deuterium oxide) produced at Princeton contained small amounts of the third isotope, tritium, but in a concentration estimated at one part in 200,000 of the "heavy water" examined. During the year the process of concentration by electrolysis has been continued and there now remains a residual ten drops from the electrolysis of seventy-five tons of ordinary water. The tritium concentration has steadily increased until it is now approximately one part of tritium for every 10,000 parts of deuterium water.



Konyak Naga warrior with decorated skull.

National Trust News.

As announced on p. 155 of this issue, *Discovery* is privileged to publish, month by month, news of the progress of the National Trust for Places of Historic Interest or Natural Beauty. This is a fitting use for the columns of a popular journal of knowledge, since the National Trust, though its primary object is the preservation of sites and buildings that would otherwise be ruined by modern vandalism or commercial shortsightedness, hardly ever acquires a new property that does not in some way further the cause of knowledge, whether humanistic or scientific.

At this very hour, for example, an appeal is being made for sufficient funds to acquire that portion of the South Devon coast known as Bolberry Down, which we illustrate on this page. Lying between Bolt Head and Bolt Tail, both portions of cliffland which are already under National Trust control, Bolberry Down is one of the scanty stretches of the South coast of England which still remain in a state of nature, "undeveloped" by the hand of man. It has been well described

as a naturalist's paradise, and is the haunt of rare birds, butterflies, and plants; the peregrine, the buzzard, and the raven still nest there, and if the land comes into the possession of the Trust they will continue to nest there unmolested, as the Trust has bye-laws prohibiting the professional egg-collector.

Other new acquisitions have been made, which help to round off several properties already held by the Trust. The amenities of Toys Hill have been further preserved for London holiday-makers by the addition of the Beacon, which commands fine views over the Weald. The Box Hill view, seriously threatened by the urbanisation of Leatherhead and Dorking, will be saved for

posterity by the acquisition of the Burford estate, an energetic local committee having by now completed the raising of the sum essential to its purchase. Similar properties have been acquired in North Devon and on the Cotswolds. And in North Wales it is expected to join hands with Mr. Clough Williams-Ellis, that stalwart protector of the beauties of one of the loveliest districts in Britain, in a further scheme of preservation. The latest accession, announced just as we go to press, is a new gift of 116 acres on the eastern shore of Coniston Water, making the National Trust property at this end of the lake nearly 150 acres.

No stain rests on the reputation of the National Trust itself; but there is a sinister side to the business all the same. From time to time the Trust's London premises—even the Secretary's private office—are invaded by one or more members of a horde of desperadoes, calling themselves "Ferguson's Gang," who, with callous effrontery, thrust sums of money into the Secretary's hand, earmarked for some purpose or other which happens to suit the Gang's policy of the moment. Neither we, nor any one outside

the Gang, has any idea who the original "Ferguson" is and, if we did, we shudder to think what fate would follow a disclosure. The money is made over to the Trust in the most suspicious way imaginable, and the gangsters are heavily disguised. A few days ago a young man, with only a flash of the eye visible between an upturned coat-collar and the vizor of his cap, forced his way into the Secretary's office and demanded peremptorily, in the Gang's name, that the £400 which he handed over should be used towards the repair of Newtown Old Town Hall in the Isle of Wight, leaving the Secretary no alternative but to accept. Scotland Yard, it seems, can do nothing.



[Photo. Western Morning News.]

Bolberry Down, a naturalist's paradise in South Devon, ripe for acquisition by the National Trust.

Discovery

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Book Reviews.

The Physick Garden; Medicinal Plants and their History. By EDITH GREY WHEELWRIGHT. (Jonathan Cape. 10s.)

The discovery of the healing value of wild herbs is undoubtedly as old as the discovery of the food value of the wild fruits, for it is only natural that the early men would turn to the great Earth Mother when in sickness or pain, knowing that she fed them when they were hungry and some pains gave more or less intensified feelings of hunger.

In the Rig Veda—one of the oldest repositories of human learning, compiled prior to B.C. 1600—we find direct reference to medicinal plants which were in use by the Aryan races of India at that time. Chinese tradition gives us the first God of Healing in Shen Nung, as well as the earliest herbal which is said to have been compiled by an emperor who ruled China, circa B.C. 2700. The Code of Hammurabi, engraved on a black diorite pillar, circa B.C. 2100, has taught us a great deal about early medical practice in Mesopotamia, and some of the drug plants which were then in use appear to be identical with those of the present day. Miss Wheelwright tells us all this and a great deal more in the early chapters of her book. Here, incidentally, we are introduced to the medicine man, who was the product of a community belief that accident and illness came from "the abyss" and was due to the anger of a shadowy underworld; his business was not so much to heal the sufferer as to release him from evil influence, a flamboyant exaggeration of fury being adopted to put the fear of Hades into the demon. Medicine among some of the early races, however, seems to have been a complicated matter, for records point to a rather formidable list of diseases. The Assyrians compounded many of their prescriptions in what was called "beer"; in most cases the proportions were carefully noted, and doctors of the day seem to have attained a high level of efficiency. The Egyptian doctor, however, was expected to do much more than merely cure his patients; he also had the task of preventing snakes from entering their houses and of driving all vermin away. From the 18th to the 31st dynasty a vigorous medical practice coincided with a high standard of living, and nearly every disease had its own physician. The Romans, on the other hand, applied their organising genius to the art of healing in much the same spirit as they undertook the task which brought 300,000 gallons of water to Rome daily; they worked systematically. Dioscorides describes about 500 plants which were used in medicine, and his book remained in use for six centuries; most of these plants belonged to the Greek flora and as such they have been identified.

Starting at Chapter V we read of the organisation of medicine from Anglo-Saxon times until the publication of the British Pharmacopoeia, in 1864. The importation of dry plants actually began in Queen Elizabeth's reign and steadily continued for about 200 years. Ipecacuanha was imported with a reputation for the cure of dysentery and was at first a "secret" remedy. Cinchona bark from Peru, appeared about 1640, being introduced by a Countess of Chinchón who had returned to Spain cured of a fever which she contracted whilst living in Peru. This drug came to England at a moment when ague was the scourge of the land, and the apothecary who cured Charles II by its use is said to have made his fortune. The famous herbal of John Gerard appeared in 1597. In his garden in Holborn, Gerard tried to grow roots and seeds which he received

from foreign lands and his search for English herbs took him far round the country that encircled the city of London, mallow and pennyroyal being gathered in the fields that are now Gray's Inn. John Parkinson's herbal was published in 1640, but it never attained the popularity of Gerard's work, although it was "more ample and exact" and contained descriptions of about 3,000 plants. The first local English flora to record the plants of a particular district was written by Thomas Johnson, who published a description of a botanical expedition to Kent in 1629.

The medicinal plants of the English flora are fairly numerous. The greater celandine is used as an alterative, diuretic, and purgative. Meadowsweet is prescribed for dropsy. The hips of the dog rose were once employed as an astringent, and the haws of the hawthorn are still used in France for kidney disease and in England as a cardiac tonic. White bryony root is used for bronchial affections. Valerian retains its place in every pharmacopoeia for its action in nervous complaints and from 1918 it has been prescribed for treating shell shock. Coltsfoot has been called "Nature's best herb for the lungs" and cough mixtures are still made from its infusion. Gentian is employed in dyspepsia and as a simple bitter tonic. Sage has been in repute for many centuries as a throat gargle. Meadow saffron increases the activity of the white corpuscles of the blood and its active principle, colchicine, is given in gouty affections. These are only a few of the well-known plants which are dealt with in detail by Miss Wheelwright, who finishes her book with some account of the trade in medicinal herbs and cultivation developments in England.

The Background of Geography. By M. WHITING SPILHAUS. (Harrap. 7s. 6d.)

With the contraction of terrestrial space, thanks to aerial travel and wireless communication, this book is a timely reminder of the work of pioneers in the exploration of the globe. "Soon the last unknown coast-line will be charted," says Mrs. Spilhaus on the last page of the text, and with that event one of the most romantic chapters in Earth's history will be closed.

Mrs. Spilhaus's writing is aimed at the romantically-minded young, and she therefore wisely refrains from delving into intricate controversy; giving instead a straightforward story of the steps that have led to our present knowledge of Earth's surface. The story is a curiously inconsequent one, with imperfections due entirely to the weaknesses of human nature. At least until the time of Captain Cook, and in certain instances even later, exploration was seldom carried out with any idea of benefiting humanity or extending general knowledge. Such knowledge as was gained was rigorously preserved for the advantage of some trading unit, whether a company or a nation, and in some instances this preservation was so successful that newly-won knowledge was actually lost for a while and cost much trouble and many lives before it was established as a universally known fact. Many of the Pacific islands, for instance, were discovered, lost, and rediscovered more than once.

A few names stand out as explorers for exploration's sake. There are the monkish and Jesuit missionaries who penetrated

Asia in the days of the Great Cham and later; trade followed them but was scarcely their principal aim. Then there are the enthusiasts for the science of navigation: Hippalus, who first studied the monsoons for the benefit of mariners, and Urdaneta who did the same service with the trade winds of the Pacific. And finally there are the genial filibusters like Dampier who, while not averse to a little mild piracy by the way, sailed the seas really for the love of the thing, and described their experiences for the good of posterity. Such figures stand out above the mass of "gold-digging" explorers, who were furtive or hectoring according to the momentary fortunes of the concern they represented.

Mrs. Spilhaus traces the story with admirable clarity and her pages make fascinating reading. Some objection might be taken here and there to the spelling of names, but there are no glaring errors. The sections dealing with geographical progress in China and Russia are brought into relation with world exploration, an important step that is too often neglected, and the index is full and efficient. When a second edition of the book appears may we ask that it should deal rather more fully with the opening up of Japan to the outside world, and perhaps contain some reference to imaginary discoveries, such as Hy Brasil and the many other legendary isles of the Atlantic?

Creation by Evolution: a Consensus of Present Day Knowledge.
Edited by FRANCES MASON. (Duckworth. 12s.6d.)

This book is the first cheap edition of a work published in 1928. In it twenty-four of the leading authorities on biology in England and the United States have set down their views on "evolution"—the incessant appearance of new qualities, new characters and new powers in living things, there being no antecedent in experience and no evident promise of such developments. Each contributor deals with a particular field of study and tells us what his findings prove, mostly in non-technical language. Professor J. Arthur Thomson, of Aberdeen University, tells us why we must be enthusiasts. He points out that "no evolutionist believes that man sprang from any living kind of ape, yet none can hesitate to believe in his emergence from a stock common to the anthropoid apes and to the early tentative men." Professor H. S. Jennings of Johns Hopkins University, asks: "Can we see evolution occurring?" He makes a special study of the microscopic amœbæ, which produce a new generation every two to four days and which have shells of definite form and structure and thus furnish an excellent opportunity for detecting hereditary alterations over a period of a year or so. There is one chapter on embryology and evolution; another on the geographical distribution of animals; and others which deal with the nature of species, the progression of life on the earth, and the records of the rocks.

It is one thing to accept evolution as a fact and quite another thing to explain the method by which the gradual change or series of changes has been brought about. Plants comprise the first study, facts relating to present-day plants being supported by evidence from fossil plants. From plants we pass to insects—butterflies and moths (on the wings of which Nature writes the story of the modifications of the species), bees (which are hardly inferior to man and most certainly have a society which is far more complex than anything in our own civilisation), and ants (a very old group of insects which attained its present stage of evolution very long ago and has since been changing very slowly and imperceptibly). Horse and elephant have been selected

as the most suitable subjects for study among animals, for the horse with its associates, unlike other animals, has on each foot only a single toe—the hoof, whilst the elephant is unique in possessing a most wonderful organ which is adapted to so many uses—the trunk. There is also a chapter devoted to the evolution of the bird, which is unquestionably a modification of some primitive reptilian type.

The book concludes with an interesting contribution by Professor Julian Huxley on progress shown in evolution, and an equally interesting one by Professor H. H. Newman, of Chicago University, on cumulative evidence for evolution. Each chapter has a brief but useful bibliography, and wherever possible the subject matter is amplified by illustrations; there is also an excellent index. Special attention seems to have been paid to the order in which the chapters appear, so that they lead up to a definite end; where there is a slight overlapping it only gives emphasis to some of the important points in the book as a whole.

Dreams in Old Norse Literature and their Affinities in Folklore.
By GEORGIA D. KELCHNER. (Cambridge University Press. 10s. 6d.)

Dr. Kelchner's book on dreams is a work of absorbing interest and contains so much original research that it will prove to be of great value to the student of this comparatively unworked field of dream literature. The account of fetches, guardian spirits, and trolls in dealing with symbolic images is of special merit. The almost bewildering varieties of symbolism which change so significantly as we pass from the heathen to the Christian attitude are of considerable interest. The historical Sagas are clearly divided into three groups, those which cover the heathen period, those which cover heathen and Christian, and those confined entirely to the Christian period. This is well illustrated in the nature of the dreams before the time when Christianity was legally established in Iceland—about 1000—and afterwards.

The dreams of Old Norse Literature are chiefly concerned with adversity but whereas in these they are connected with hostilities of men against men those in folklore are far more connected with the perils arising from the forces of nature such as epidemics or famine. Dreams of good fortune are comparatively rare.

The fetches in dreams are represented frequently by animals which have some resemblance to the person to whom the fetch is attached, but there is considerable variety. A wolf is often the recognised form. In Danish folklore the viper is largely associated with evil people.

In the section on guardian spirits, which is dealt with fairly exhaustively by Dr. Kelchner, the failure of a man to dream and who therefore has no guardian spirit is considered an abnormality. Prophetic dreams which nearly always come true are very common in the guardian spirit series; many dreams which are related of fatal accidents occurring to friends at a distance are said to have been proved to be exact records of actual events.

In Old Norse Literature dreams fall naturally into two distinct categories, namely, the heathen and the Christian Saint. Two remarkable dreams are recorded of dreamers who received physical injuries inflicted by the dead people of whom they were dreaming.

An interesting point is discussed as to how far the dream in

Old Norse Literature is a pure literary convention and how far it is the expression of actual experience. In contrast to the announcement and direction in folklore with its insistence on life beyond the grave, it is the prophetic dream which tends to predominate in Old Norse Literature, as being a convenient means of welding together literary material. It is suggested that the simpler the dream the more likely it is to approximate to real experience.

An abnormally comprehensive appendix with texts and translations adds considerably to the value of the book and will be a veritable God-send to the student of dreams.

C. W. KIMMINS.

Useful Aspects of Geology. By S. J. SHAND. (Second edition; Murby. 6s.)

Many people will remember Professor Shand as the author of several authoritative and delightfully written books dealing with the subject of Petrology, and though most students of geology associate him most especially with his works on this subject, he is besides, an able exponent of what may be termed "popular geology." These views and explanations of the broader outlook on geological science and its applications, such as those in the volume under review, are precisely those most likely to fall into the hands of non-specialists desiring to enlarge their sphere of interest in this particular direction. Such a work may be expected to meet with a very favourable reception from persons new to the subject; and here it is, in its second edition. In quite simple language the author demonstrates the value of a knowledge of geology when applied to many problems of to-day, besides giving his readers an elementary introduction to the science. This little volume will be found very suitable as a first and explanatory textbook for students working on courses in which a certain amount of work in Geology is necessary.

Experimental Bacteriology. By W. KOLLE and H. HETSCH. Translated from the German by DAGNY ERIKSON and edited by JOHN EYRE. (Allen & Unwin) 2 vols.: 30s. each volume.)

"Kolle and Hetsch," as it was generally spoken of, has been well-known to most senior bacteriology students for many years and, after being translated into various languages, the seventh edition has at last been translated into English. Though its title is *Experimental Bacteriology in its Application to the Diagnosis, Epidemiology, and Immunology of Infectious Diseases*, the second volume, with the exception of two chapters on tuberculosis and leprosy, is given up to spirochaetes and spirochetal diseases, protozoa and protozoal diseases, the filterable viruses and virus diseases and a final chapter on the diseases caused by filamentous fungi and yeasts. The chapters on helminth infections, Ankylostomiasis, Bilharzia, etc., have been deleted from the seventh edition.

The plan of the book is to deal first with the general morphology and biology of the pathogenic bacteria, and to pass on to immunity and serum reactions, all of which are dealt with in a rather sketchy manner, the question of flagellar and somatic antigens being practically ignored, and then to deal with the specific diseases, the most important of which are accorded a chapter each. This plan is employed also for dealing with the protozoal and other diseases.

A chapter on a specific disease has a short historical survey,

a brief description of the causal organism, the clinical cause of the disease, its cure and prevention, notes on infection and diagnosis, etc., the whole giving a wide if rather bird's-eye view of the disease. One of the most valuable points of this book, especially to the student not particularly specialising in bacteriology, is the spirit in which the chapters are written, a real understanding of the fact that the clinical side and the laboratory side cannot be divorced. Though Koch's postulates are not mentioned as such, Kolle, who was a pupil of Robert Koch, has never forgotten the teachings of his master. These chapters give a brief, though complete, rather than a detailed account, and are written in a style that makes continuous readings possible, which should appeal to the lay reader. In fact the lay reader, if he ever attacks so large a work, can get a very good idea of what the bacteriologist and laboratory worker has accomplished and the manner in which he does his work.

The bane of all writers of text-books must be the thought of future editions and the necessity of rewriting. Though the edition has been completely revised it has apparently not been extensively rewritten, and many of the methods given have been superseded by others which, though modern, are not necessarily unsound. The great majority of post-war work is ignored, especially that done outside Germany.

It is no mean task to translate and edit such a work, and this has been well done on the whole, but one or two foolish mistakes have been allowed to slip in; more trouble should have been taken to get the customary English equivalents, as in the chapter on Gas Oedema; there is no differentiation between Actinomycosis and Actinobacillosis—in fact, the question of nomenclature is politely ignored.

The book is well illustrated, the reproduction of the many coloured plates is good. In this edition the bibliography has been very greatly reduced, and little attempt has been made to bring it up-to-date. Such references as are given are almost entirely German.

A. F. B. STANDFAST.

Manual Skill: Its Organisation and Development. By J. W. COX. (Cambridge University Press. 16s.)

Perhaps in our lifetime the physiologists, the psychoanalysts, the *gestalt*-theorists, the behaviourists, and the experimental psychologists will find themselves able to make significant remarks to each other. But meanwhile it is from the experimentalists who are concerned with the assessment of mental and physical abilities that we seem most likely soon to get results which will affect our daily life. From their researches will come the opportunity of accurate guidance in our choice of profession or job. This careful work of Dr. Cox is typical of such researches. He carried out an investigation for the National Institute of Industrial Psychology into the problems of manual skill. Can manual skill be measured? How far does it depend on special manipulative abilities? Or on intelligence? Is skill best developed by practice in the specific operation or by general training in the principles of movement? How much of the acquisition of skill depends on muscular education? and how much on improved mental organisation? How far can skill required in one operation be transferred to another? Such are the questions he set out to answer.

In order to simplify the field of research Dr. Cox chose as the basis of his tests an operation which is typical of a vast number of manipulative jobs in industry—the assembly of an ordinary electric-lampholder consisting of eighteen parts. The complete

operation could be broken up into a number of subdivisions involving higher and lower forms of skill. The tests consisted in measuring the times in which groups of subjects of all ages and both sexes performed the various operations and sub-operations under many different conditions of practice, training, and incentive. Some subjects were familiar with the objects, some had never seen the ordinary lamp-holder in pieces before.

The data obtained in this way are not accepted as significant without careful checks for internal consistency, and the early part of the book is devoted to the necessary discovery and elimination of sampling errors, after which analysis proceeds by inter-correlation and the Spearman criterion of the tetrad difference.

Dr. Cox's conclusions may be briefly summarised. Loose terms in common use such as "mechanical ability" or "manual dexterity" do not correspond to independent mental entities. Instead he finds that the "general intelligence" factor of Professor Spearman is the most universal determinant of skill. A "mechanical factor" is also important where the assembling operation involves a specially mechanical problem: and a "routine manual factor" where the assembling is simple and involves no mental effort at all. Rapidity in assembly work depends on the greater or less degree to which the operative possesses the abilities determined by these factors, and also upon the greater or less "saturation" of the job by these factors. There are likely to be no pure tests for these factors, but a co-ordinated group of tests will allow us to deduce in advance the ability of anyone to acquire a particular skill.

So far as the transference of skill is concerned, Dr. Cox is able to show that practice which is only repetition results in the acquiring of a skill which cannot be transferred to other operations. Skill which is developed by training in the principles of movement seems to be transferable, so that the learning period for other jobs is shortened.

A. HUDSON DAVIES.

The Family Book. Edited by GWEN ST. AUBYN. (Arthur Barker. 8s. 6d.)

It is a pleasure to come upon a book so comprehensive and full of common sense, and one dealing with the problems of the normal young. The great majority of books on the subject of upbringing deal only with the difficult or abnormal child, a problem which luckily does not concern most parents.

Mrs. St. Aubyn has succeeded in collecting a representative team of experts on various subjects appertaining to family life. All of them have treated their several chapters with knowledge and insight and have shown themselves straightforward and clear-headed. The resultant book covers the life of the family from the pre-marriage era of the parents to the setting out into the world of the offspring of these parents.

The Family Book does not try to impose its views on its readers, but it endeavours to express its authors' opinions clearly so that the said readers may be helped and enlightened, while suiting their own needs. It embodies a fair *expose* of parenthood, and happy are the parents who can separate the oats from the chaff and make a success of their children thereby; and if they are lucky enough to possess healthy, normal, contented young animals as children this success should be easily attainable.

It is perhaps inevitable that the book should apply to one class of society only; for the less happily circumstanced classes here are no two ways of educating the child (see L. A. G.

Strong's admirable article on the education of boys); the more or less leisured class is the only one that can sit down, read, study, and—even then, perhaps—become more perplexed than ever at the alternatives that offer themselves.

Extreme and "modern" views have no place in this book, and I have no hesitation in recommending it for its simple and outspoken common sense. Everyone interested in creating a family and in making a success of it ought to read and own this book; and it should be given, not lent, to one's friends.

Psychology and Health. By H. BANISTER. (Cambridge University Press. 7s. 6d.)

Your Mind and Mine. By RAYMOND B. CATTELL. (Harrap. 7s. 6d.)

An Introduction to the Theory and Practice of Psychology. By LL. WYNN JONES. (Macmillan. 12s. 6d.)

Each of these three books is addressed to a different audience. The author of *Your Mind and Mine* takes the enquiring layman by the arm and tells him what a captivating science psychology has become and unfolds for him the "greatest problem awaiting to be unravelled by spirited and adventurous intellects." There are very many popular books of psychology, but too often the authors do not know their subject as a whole or do not know how to write, and sometimes they suffer from both disabilities. Raymond Cattell, however, is a working scientist who is at home in all the departments of normal psychology, and he commands a clear, cogent, and often amusing style. The architecture of the book is mainly historical with a grouping round significant personalities, and it is copiously illustrated with photographs which are frankly dramatic and interesting rather than complementary to the text. If we look for the reason why a professional psychologist should have been at such pains to popularise his subject, we may find it perhaps on the last page, in his hope that "when individuals are more enlightened as to their own psychology we may confidently look to a dissolution of the harsher, cruder, and more obstructive features of society."

An Introduction to the Theory and Practice of Psychology, which is written for the student of psychology, is rather more specific than its title indicates, for it is founded on the teachings of the Spearman or noegenetic school and in addition to most of the standard methods it includes sections on the measurement of such special faculties as retentivity, fluency, and wit; and to those unacquainted with this school, who may wonder that such things should be thought measurable, the following comment from *Your Mind and Mine* may be offered:—"Everything that exists exists in some amount, and it is only a matter of time before it can be measured—although it may be another matter to evaluate it." The book is arranged as a series of demonstration lectures followed by a discussion of principles; it is clearly and succinctly written and admirably serves its purpose of making the student familiar with the principles of the Spearman school and enabling him to test them.

Psychology and Health is written for medical students and practitioners because "it is life itself, the life of the whole man, that the physician should learn to understand, for the art of living is the greater part of the art of healing" and "sometimes a book may help those who are groping for a way which they know to be there, but cannot find." There is, however, little need for the physician to continue to grope, since several competent books have already been written for his guidance and there is little in this book to recommend it over its predecessors.

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CONTENTS.

	PAGE
Notes of the Month	155
New Biblical Texts	157
The British Canning Industry	161
Art in African Literature	164
The Future of British Mammals	167
Detecting Milk Frauds	170
New Light on Irish Antiquity	172
Correspondence	174
What are Scientists?	175
The Ethics of Headhunting	178
Mass-3 Hydrogen	179
National Trust News	180
Book Reviews	181

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